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A REPORT ON DEEPSEA LONGLINE FISHING FOR TUNA IN THE PHILIPPINES

By DOMINGO D. TAPIADOR
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INTRODUCTION

Although the waters of the Philippines have long been known to be abundant in tuna, the fishery for tuna in the country has remained almost unexploited and undeveloped. There had been some efforts exerted in the past develop a Philippine tuna industry, but these were undertaken mostly by the Japanese, the Americans, and the Formosans (Taiwanese). (Martin, 1938; Domantay, 1940; Warfel, 1950).

The development of the industry has been greatly stimulated with the recent establishment in Manila of the Pacific Fishing Development Company, a Filipino firm, engaged in deepsea fishing for tuna. Two moderate-sized fishing vessels especially adapted for tuna longline fishing (one of which is shown in Figure 1) were used by the company and the results of their operations show promising prospects for the tuna industry. For the nine trips they made in nine months to the tuna fishing grounds in the Sulu Sea, and around Palawan and Western Mindoro, the two vessels landed a total of more than 100 tons of tuna and tuna-like fish.

FIGURE 1. The tuna longliner M/B **Dinia**. Note the large foredeck space and the low pilot house construction.

These fishing boats used the tuna longline exclusively. This gear is similar to the Japanese longline and was brought to the Philippines from Taiwan along with the two fishing boats and some Taiwanese fishermen.

In an attempt to encourage Filipino fishermen to engage more seriously in tuna fishing, observations made on board the two fishing vessels on the methods of operation of the longline and the fishing grounds explored are presented in this paper.

THE TUNA LONGLINE FISHING GEAR

General description. — The tuna longline used by the Pacific Fishing Development Company for catching tuna and tuna-like fish consists of an extremely long line with a multiple series of baited hooks and is set to drift at subsurface levels of the sea. The depth at which the gear is set varies with the species of fish desired.

A set of tuna longline is several miles long. For convenience in operation, handling and stowage, the tuna longline is divided into units called baskets (Figure 2). Each basket actually con-

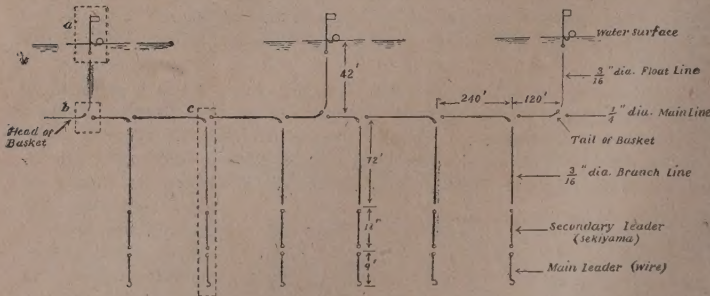

FIGURE 2. Diagram showing a unit or basket of tuna longline gear as used by the **Dinia** and the **Nelly**. Details of insets **a** and **c** are shown in **Figures** 3 and 4 respectively.

stitutes one complete unit of the longline gear. From 80 to 90 baskets of longlines are joined together as a set in actual fishing. Since all the units or baskets are identical in construction, it will suffice to describe only one basket.

A unit of the tuna longline has the following parts and attachments: main longline, branch lines, leaders, hooks, float lines, flagpoles, buoys, swivels, "sekiyamas", and hooks.

The main line. — The main line is the part of the gear that is suspended horizontally below the surface of the water. To this main line the lower ends of the float lines and the upper ends of the branch lines are attached. It is made of Manila rope one-fourth inch in diameter and about 1,440 feet long and is lightly tarred. It is divided into six sections corresponding to the number of hooks in the basket. These sections are connected end to end by knots which could be easily untied. The division of the main

line into sections serves two purposes. When a part of the main line kinks or twists during the hauling operation, the line is promptly straightened out by untying the knots joining the affected section or sections and re-joining them when the twists are removed. This system also permits removal of a section or sections of the line when the fishing operation so requires.

The float line. — The main line is held in a horizontal position below the surface of the sea by means of float lines. To the upper end of each float line a buoy and a flagpole marker is attached. The float line is made of Manila rope 36 to 48 feet long and 3/16 inch or 1/4 inch in diameter. There are two regular

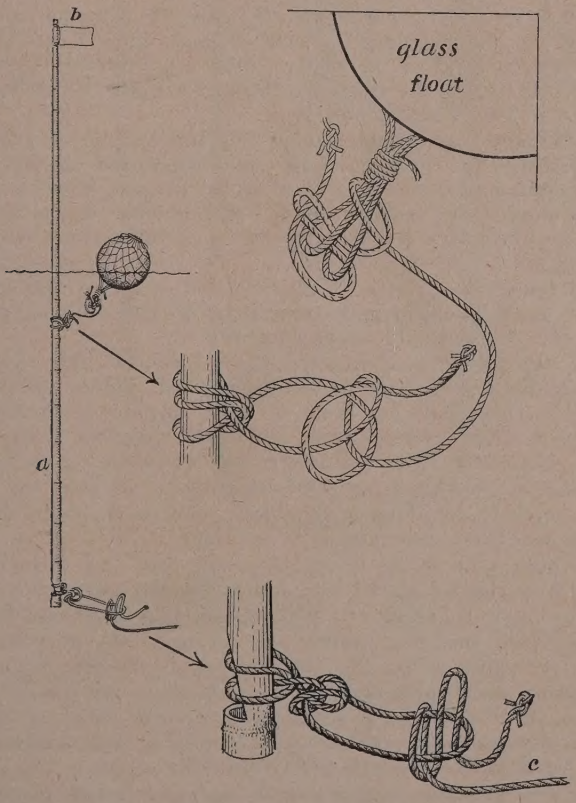

FIGURE 3. Details of buoy and flagpole attachments: a, bamboo flagpole; b, colored cloth flag; and c, top end of floatline.

float lines in a basket, one at the "head" or beginning and the other at the "tail" or end. There is also an intermediate float line in the midsection of the basket as shown in Figure 2. This, however, is not used when a greater sag in the main line is desired.

The flagpoles (Figure 3) are made of bamboo poles about 12 feet long with a mean diameter of 5/8 inch. These poles are used as markers to indicate the position of the longline gear in the water. To make them conspicuous, they are provided with small colored cloth flags at the tip. The flagpole is kept upright in the water by tying the top end of the float line to the base of the flagpole and tying the glass float at some distance from the base. Carbide lamps are used at specific points along the main line to serve as night markers.

Hollow spherical glass floats 12 inches in diameter are used as buoys for the longline. Each of these glass floats gives a buoyant effect of about 15 kilos. They are protected from concussions and tied to the flagpoles through a tight fitting bag netting with a 2-to 4-inch mesh.

The branch line (Figure 4). — The branch lines are the sections to which the hooks are tied and suspended in the water. They are hung from the main line at an average interval of 240 feet. A branch line is composed of the following: the branch line proper, the secondary leader or "sekiyama", the main wire leader, and the hook.

The branch line proper is made of cotton twine 3/16 inch in diameter and varies in length from 55 to 75 feet with an average of 72 feet. It is usually heavily tarred.

The "sekiyama" is a cotton-wound, 4-strand wire rope 1/16 inch in diameter and 18 to 19 feet long. This tightly wound "sekiyama" is rigid, will not kink or twist, and tends to keep the baited hook away from getting entangled with the branch line proper. The cotton twine winding of the "sekiyama" is coated with either wax or paraffin to prevent the rusting of the wire.

The main leader is made of pliable, galvanized, 4-strand, 1/16 inch diameter wire rope and is 9 feet long.

The hook used is the typical Japanese-type tuna hook. It is made of a special tin-plated iron and is durable and rust-resistant.

A box-type, brass swivel 3 1/2 inches long is placed between the "sekiyama" and the branch line proper. Its purpose is to minimize twisting of the line after a fish is hooked.

Accesory deck equipment. — In addition to the regular longline gear, there are several accessory equipment used for longline fishing. Among these are the mechanical line hauler, deck roller fairlead, gaff hooks, mallets, and icing tools.

The line hauler is a mechanically operated winch installed at the forward end, starboard corner of the fish hold hatch coamings. It consists of an enclosed gear body with a clutch and a hand

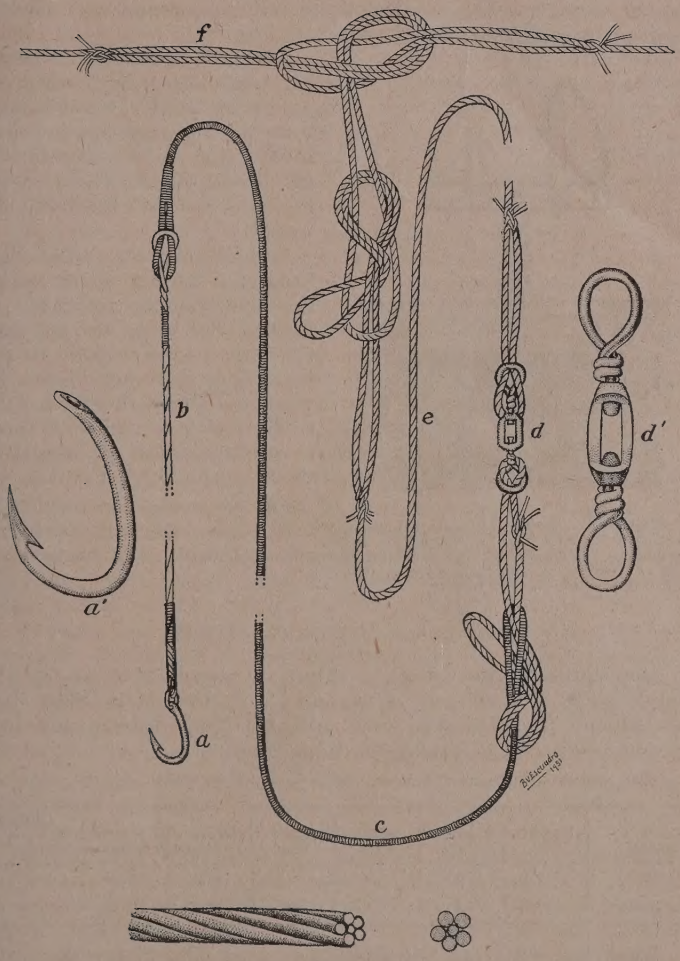

FIGURE 4. Details of branch line connections: **a**, tuna hook; **b**, main wire leader (cotton-wound sekiyama); **d**, swivel; **e**, branch line proper; and **f**, end of main line. Shown at bottom is a cross-section of wire leader.

lever brake. The main line is hauled in by means of two main sheaves and a pressure idler sheave located outside of the body.

The detachable three-roller fairlead is installed on the starboard deck rail of the vessel to keep the main line aligned as it passes through the line hauler from the water. It consists of

one horizontal and two vertical brass rollers mounted on a revolving iron base (Figure 5).

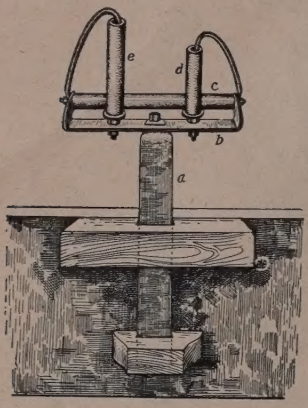

FIGURE 5. Roller fairlead as installed on forward deck rail of longline vessel showing **a**, iron support; **b**, revolving iron base of rollers; **c**, horizontal brass roller; **e** and **d**, vertical brass rollers.

The gaff hooks are of several types. There is a one-hand gaff hook with a wooden handle, a two-rope-handle gaff hook, and a bamboo-handle gaff hook. These are used for handling the fish on board the vessel.

Three different mallets are used for killing or stunning the fish when being hauled on board. The large wooden mallet with a long wooden handle is used on the sharks, and the small mallet on the tuna. The small flat-iron mallet is used to stun spearfish by pounding them on the tip of the nose.

For icing the fish inside the fish holds, specially made ice rakes, shovels, and baskets are used.

THE TUNA LONGLINE VESSEL

Description of the vessel. — The two vessels used by the Pacific Fishing Development Company were the M/B **Nelly** and M/B **Dinia.** These vessels were acquired from Taiwan and they represent the typical Taiwanese tuna longliner.

The specifications of these vessels are as follows:

Name of Vessel	Length Feet	Breadth Feet	Depth Feet	Draft Feet	Gross Tonnage	Net Tonnage	Cruising Speed Knots
M/B Nelly	71.00	17.00	8.25	6.00	47.27	27.43	6.0 to 6.5
M/B Dinia	64.50	16.50	7.00	5.50	38.32	20.71	7.0 to 7.5

Since the **Nelly** and the **Dinia** are practically of the same design and features, only one, the **Dinia**, (Figure 1), is described in the following paragraphs:

The vessel is of wooden construction and is a typical Japanese sampan-type V-bottom hull.

As designed the **Dinia** is remarkably seaworthy. With a relatively deep draft and low center of gravity, the vessel has a very low metacenter which enables it to float in almost perfect equilibrium. With its V-shaped bottom the boat pitches and rolls less

than the ordinary round-bottom vessel of similar design. An important feature of the vessel is the dry, permanent and empty ballast on each side of the boat which serves as an extension of the main deck. This feature, designed with great ingenuity, is intended to increase the stability of the vessel. To further lower the center of gravity and reduce windage resistance and add to the boat's stability, the crew's quarter is built low so that it appears as a small and cramped-up space of the deckhouse set on a mere level of the deck.

The vessel is built with a moderately low deck to suit the requirements of tuna longline fishing. The low fore and aft decks greatly facilitate the hauling and setting of the longline gear. The fore deck has a wide room to receive the gear as it comes in from the water. The hatches of the fish holds are located close to where the fish are landed on board. To facilitate hauling of heavy fish, the bulwark or side rails have a removable section on both sides of the vessel. The aft deck has sufficient space for stowing and handling of the baskets of gear while the top of the deckhouse has also enough space for the rest of the baskets of line and is provided with a stockade for the buoys and flagpoles.

The vessel can carry fuel oil sufficient for a fishing trip of 25 to 30 days. In the engine room there are six fuel oil storage tanks with a total capacity of about 1,500 gallons and one service (day) tank with a capacity of 120 gallons. There is also a lubricating oil tank with a capacity of 120 gallons.

The fish and ice holds of the vessel can take in 25 to 30 tons of crushed ice and 20 to 25 tons of fish and can keep the fish in good condition for a period of 7 to 12 days. There are four fish holds, two ice holds, and one chain locker. The holds are provided with intermediate hatch covers. The large space between the two overlapping hatch covers provides good insulation.

The engine. — The source of power for propulsion, electricity, and for line hauling is a heavy-duty, low speed, 2-cylinder, 2-cycle, Japanese-made, semi-diesel engine with a capacity of about 85 h.p. at 300 r.p.m. It is started by means of a compressed air system provided with preliminary "explosive powder" ignition. The fuel used is lowgrade bunker C oil which is pre-heated at the exhaust manifold before it reaches the mechanical fuel injection pump. The saltwater used for cooling the engine is also made to pass through the exhaust manifold. The exhaust water leaving the engine at the side of the vessel is hot and is used for varied purposes on deck, especially for washing oily and greasy utensils.

The engine is of the direct reversible type and is provided with a clutch which can be disengaged to neutral or engaged to forward or reverse positions.

Auxiliaries.—The vessel has a one-horsepower generator, two auxiliary pumps and two ordinary hand pumps. The generator

supplies electric power for lighting the vessel and is directly connected to the flywheel of the engine by means of an ordinary canvas belting. The cooling water pump and the bilge pump are connected to the propeller shaft close to the engine by means of cam gear. Both pumps are of the horizontal reciprocating type. The two hand pumps, one for freshwater and the other for bilge water, are located on the aft deck. The freshwater pump gets water from two tanks of 50 gallons capacity each which are on the port and starboard sides of the vessel below deck aft of the engine room.

LONGLINE FISHING OPERATION

Tuna longline fishing involves three distinct phases of operation; namely, setting of the lines, patrolling, and hauling in of the lines.

Preparation of the Gear.—The longline gear is carefully examined and rearranged in the baskets. The main line, the float lines, and the branch lines are checked, coiled and stacked inside the baskets in their proper sequence. The hooks are hung on a piece of line inside the basket just below the rim. The free ends of the coils of the main and the float lines are hung at the side of the basket to facilitate joining with other units when setting (Figure 6). The readied baskets are arranged at the stern the day before the setting.

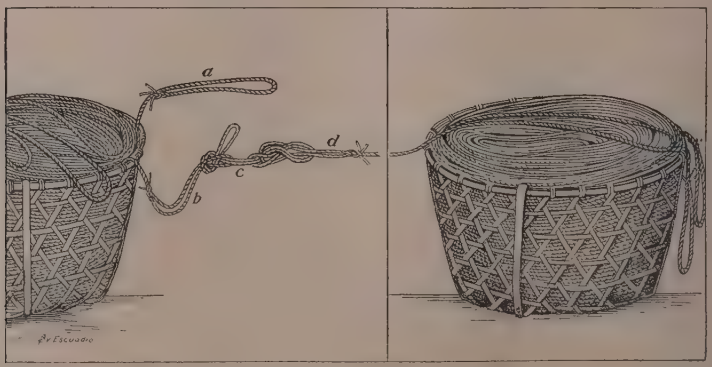

FIGURE 6. Method of joining baskets of gear. Basket shown at left contains lines being set; basket at right is succeeding basket. Illustration shows **a**, free top end of middle floatline; **b**, "tail" of basket; **c**, loop sling commonly used to join ends of main line; and **d**, "head" of new basket.

Setting.—The setting of the gear starts at early dawn, usually at about four or five o'clock, and takes three to four hours to finish. The line is set from the stern as the vessel moves forward on a straight course with a speed of from 4 to 5 knots. It is

set either diagonal to or across the current. The lines are thrown fast overboard to have a slack of around 30 to 45 percent. The total length of the main line when set in the water is from 12 to 15 nautical miles. Since the total length of the main lines of 90 baskets is about 21 nautical miles, the slack on the lines effected is roughly between 6 and 9 nautical miles.

Excluding the navigator and the engineer, at least five fishermen are required to set the longline. These are the following: (1) the "basketman" who prepares and joins the line in each basket; (2) the "baitman" who puts the bangos fish baits on the hooks; (3) the "lineman" who handles the coiled lines in the baskets and throws them overboard at the proper time; (4) the "buoyman" who ties the flagpole to the free (upper) end of the float line; and (5) the "flagpoleman" who selects the flagpole with the right cloth flag color and who ties the glass floats to the flagpoles. During the setting process, the basketman stays at the stern deck where the baskets of line are located; the baitman and the lineman at the portside corner of the stern; the buoyman at the starboard corner of the stern; and the flagpoleman at the aft top, portside corner of the deckhouse close to the stowed glass floats and flagpoles.

In starting to set the lines, the flagpoleman ties a glass float to a flagpole and the buoyman ties the flagpole to the free end of the first float line (Figure 7). Also tied by the buoyman to

FIGURE 7. Setting operation. Left shows "flagpoleman" after having tied glass float to flagpole and ready to hand pole and buoy to "buoyman" shown at right who, in turn, ties bottom end of flagpole to free end of floatline.

this first flagpole is an iron sinker weighing about two kilograms. This sinker makes the pole stand upright in the water. The flagpole thus prepared is cast overboard by the buoyman followed immediately by the coil of main line thrown by the lineman. Following the casting of the main line, the baitman, who in the meantime has baited the hook, throws the coil of branch line with the baited hook in the water (Figure 8). This coordinated sequence of work of the lineman and the baitman is repeated as many times as there are hooks. Before all the coils in a basket are cast overboard the basketman has already joined the "tail" end of the line in the last basket with the "head" end of the line of the next basket. The buoyman and the flagpoleman coordinate their phase of the work with that of the lineman and the baitman and in this manner the setting is accomplished with a minimum of interruption.

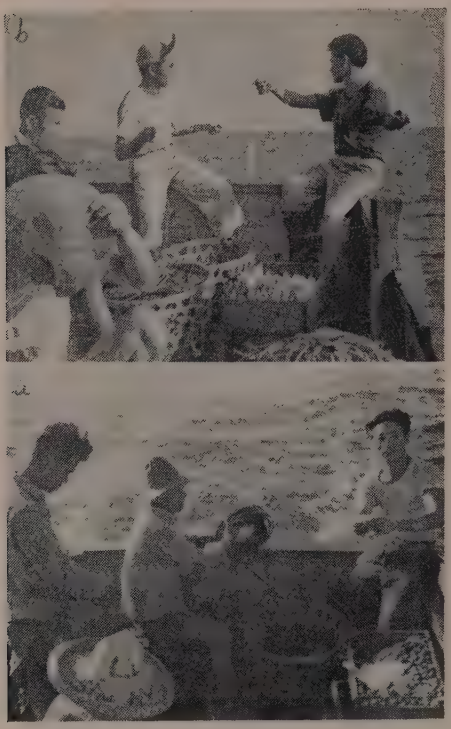

FIGURE 8. Setting operation. Bottom picture shows "baitman" at right baiting hook with bangos fingerling. At right foreground is box of baits. "Lineman" at middle holds coils of main line ready to be cast overboard. "Basketman" at left joins a new basket to basket being set. Top picture shows "baitman" (right) about to cast baited hook.

With the exception of the two at the ends of the line, all the flagpoles are set in the water without sinkers. They are kept in upright positions by the weight of the whole line. The majority of the flagpoles have either white or black cloth flags. These two colors are used alternately throughout the length of the main line except at the ends and in places where the flagpoles with red flags are used. The flagpoles with red cloth flags indicate the

points along the line where carbide lamps are substituted for flagpoles during patrol operation. These red flags are placed at a point indicating the last, second last, and third last 15 baskets of line, counted from the hauling end. A flagpole with a large yellow cloth flag is used at the end of the line to make that point conspicuous.

After the setting is completed, the vessel moves some distance tance away from the set lines. It always stays on the windward side of the set lines so that when it drifts the direction would be toward and not away from the line. The members of the crew then take a late breakfast and rest.

While the others rest the machinist or some other crew member prepares the carbide lamps (Figure 9). He removes the used carbide, cleans the container and fills it with a new supply of carbide to about two-thirds of its capacity. He tests and adjusts the water-regulating screw so that water will enter the carbide receptacle at the rate of about one drop per second. The rubber tube is also inspected and tested.

Patrolling.—Patrol work along the entire length of the set line starts at about ten o'clock in the morning or about two hours after the setting operation. It is done for three main purposes; namely, (1) to place the lighted carbide lamps as night markers; (2) to haul fish on board as quickly as they are caught to prevent damage by sharks; and (3) to remove any entangled section or sections of the line.

At the start of patrol work the last flagpole and glass float are brought on board. The free end of the carbide lamp line together with the lower end of the float line is tied to the main line. The carbide lamp is lighted and, together with the last glass float set on the water. The vessel steers along the line and maintains a distance of 100 to 150 feet from the markers.

The vessel patrols at a speed of about 3 or 4 knots. The speed, however, is increased specially when the catch is heavy to enable the crew to finish the patrol work in about 3 hours. During times of especially good catch, the patrol work may last up to about hauling time. During the patrol each glass float is closely watched. Its abnormal position generally indicates that a fish is caught on the line. In addition. it may also indicate the condition. size, and species of the fish caught. as follow:

1. Condition of the fish.
   a. The glass float bobs up and down when the fish caught is still alive.
   b. The glass float remains submerged at a fixed position below that of its normal floating position when the fish caught is already weak or dead.
2. Size of the fish.
   a. The glass float submerges fully or about three-fourths its length from the surface of the water when the fish caught is large.

b. The glass float submerges only a little below its normal floating position when the fish is small.

3. Species of fish.
There is a much greater submersion of the glass float when

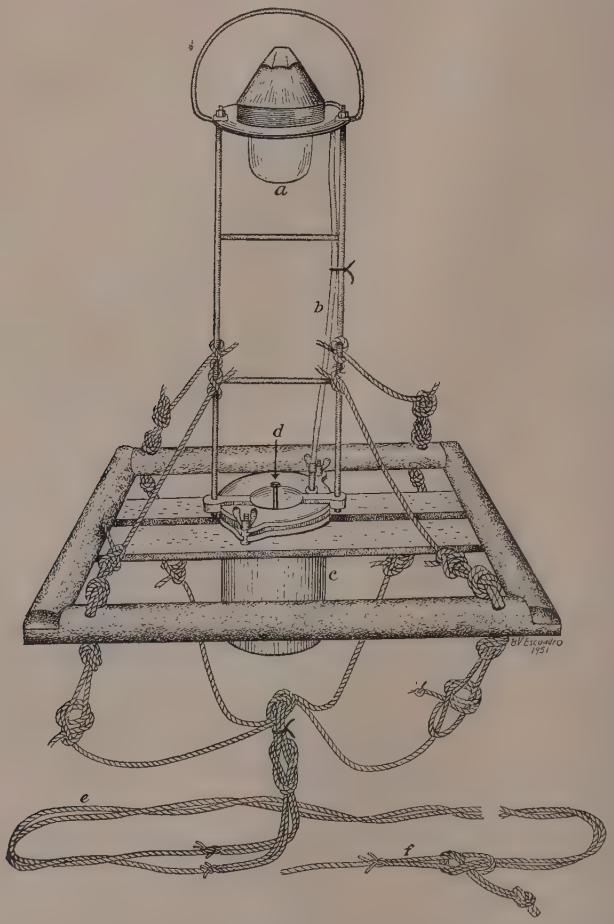

FIGURE 9. Carbide lamp night marker showing **a**, glass cover for light; **b**, rubber tube; **c**, carbide container; **d**, water-regulating screw; **e**, double line for connection with main line; and **f**, end of main line.

the fish caught is either a shark or a swordfish than when the fish caught is a tuna.

In each and every case, however, keen observation is needed to detect the presence of fish on the line.

When a buoy indicates a catch the vessel is maneuvered close to the line in the direction of the float. A fisherman stations himself at or near the bow with a long pointless gaff hook. He hooks the buoy and brings it up on deck. The float line is then pulled up and with it that section of the main line bearing the load. When a part of the branch line comes on board and it is felt certain that there is a catch, it is detached from the main line and is immediately replaced with a new and baited branch line a number of which are kept ready on deck as replacements. The float, the flagpole and the main line together with the new branch line are then returned to the water. As the detached branch line is being pulled on board two men stand ready to hook the fish as it comes out of the water. An even tension on the branch line is maintained in case the fish is still alive to prevent the line from snapping or the fish from cutting loose. When the fish is finally brought to the side of the vessel, it is hooked and landed on deck. Care is taken that the fish is hooked only at the stomach portion to keep the smooth appearance of the fish. The fish is brought on board from either the port or starboard side depending on which side the man on the bow had hooked the buoy from the water.

Hauling.—Hauling in of the lines starts at about five o'clock in the afternoon at the end of the line which was last patrolled.

The hauling operation is the most difficult and complicated phase of tuna longline fishing. As in setting, work is divided among the crew with frequent shifts as the situation demands. At least six persons are needed for the hauling operation, namely, (1) the "gurdyman" who operates the line hauler, maintains its proper speed, and applies the brake and clutch as necessary; (2) the "lineman" who takes in the branch lines manually as fast as they come in. He has to keep pace with the speed of the line hauler and therefore is the busiest man on the hauling team and consequently is most frequently replaced; (3) the "buoyman" who pulls in the float line and stows the flagpole and the glass floats separately on top of the deckhouse; (4) the "first coilman" who arranges the coils of the main line that drop from the line hauler and coils the float line; (5) the "second coilman" who receives the coils of main line, branch lines, and float lines and stacks them in the baskets for stowage; and (6) the "basketman" who stows the basket containers with the hauled lines at the aft deck and on top of the deckhouse.

Before hauling starts, the members of the hauling team prepare their respective equipment. The "gurdyman" checks the line hauler, places the rubber sheave lining on the main puller sheave and the line receiving board on the aft platform of the gurdy.

When the engine is started, the beltings for the gurdy shaft and the electric generator are coupled to the engine flywheel.

With everything ready, the six crew members station themselves in their proper places while at least two men stand by ready to help in any phase of the operation. Other crew members wait for their turn to substitute for the men working. The vessel now heads for the end flagpole marker with the large yellow cloth flag. The buoy is hooked and taken aboard. The main line is picked up and passed through the roller fairlead and then fed to the rotating sheaves of the line hauler (Figure 10). The first coilman picks up the dropping coils of the line and arranges them from the line receiving board. These coils are then passed on to the second coilman who stacks them neatly in the basket containers.

FIGURE 10. Hauling operation. Top picture shows "gurdyman" holding clutch of line hauler and maintaining steady watch on lines coming in. Bottom picture shows "first coilman" (right) arranging coils of line dropping from gurdy. In foreground is shown "second coilman" putting and arranging coils in basket and behind is "basketman" ready to take basket of lines from him for stowage.

The lines are pulled mechanically by the line hauler at the rate of about 390 feet per minute with the main sheave rotating at a speed of about 180 r.p.m. It is often necessary, however, to lessen the speed or stop the line hauler. The gurdyman uses the hand lever brake and the clutch for the purpose.

The lineman pulls and coils the branch lines manually and hands them to the second coilman who, in turn, stacks them inside the baskets. During the last day of fishing operatoin, the section of the branch line with the

hook, leader, and sekiyama is detached and separately stacked in one basket.

The buoyman takes in the float line by hand as it comes up with the main line. He unties the flagpole and removes the glass float from the pole and stows both on top of the deckhouse.

When there is a catch the lineman detaches the branch from the main line and hands it to a crew member. The second coilman ties another branch line in its place before stacking the rest of the line in the basket. The crew member who receives the "loaded" branch line pulls it in while other men stand by to hook the fish. The type of hook used to bring the fish in from the water varies with the size, condition, and species of the fish. The hooks used are the following:

FIGURE 11. Hauling operation. Upper picture, yellowfin tuna brought aboard by a pair of wooden handle gaff hooks. Shown behind man at right is a portion of bulwark from which a detachable section has been removed to facilitate hauling in of fish. Bottom picture, retrieved baits being washed and cleaned after hauling operation for re-use.

1. Small iron gaff hook, with a long wooden handle. This is used principally for hooking tuna. A pair is usually used with tuna larger than the 40-kilogram class (Figure 11).

2. Large iron gaff hook, with a long shank and a long rope handle. This is used to haul in the large sharks which are usually alive when caught. Other large species like the swordfish and sailfish are also brought in with this type of hook. The hook is thrust into the mouth of the fish while still in the water beside the vessel, and the rope handle is pulled on board by at least two men. If the shark is still alive, which usually is the case, it is hooked and hung on the side of

the vessel where it is pounded at the head with a large wooden mallet. When it is already weak or dead, the shark is pulled aboard. Spearfish are pounded at the tip of the nose with an iron mallet before they are brought on board.

3. Large iron gaff hook, with a short shank and a long rope handle. This is used to hook small sharks and spearfish. It is also used in combination with the preceding (No. 2) type.

The longline gear is retrieved on the starboard side with the vessel running at a speed of 2 to 4 knots. The vessel has to make stops frequently during retrieving operation to adjust itself in relation to the line being hauled in. The line is always retrieved from a direction perpendicular to the longitudinal axis of the vessel. When the vessel has to stop, the engine is kept running as the line hauler must take in the main line continuously. The boat is also stopped when there is some entanglement of the line which often happens when there is a strong current or when a strong and large fish is caught. The section or sections affected are removed and fixed by the rest of the crew members.

Each basket of line when completed is stowed away by the basketman at the aft deck and on top of the deckhouse.

The hauling operation takes about six to seven hours, usually ending at about midnight. When all the fish have been stored in the fish holds, the crew takes a midnight snack.

THE CATCH

Handling of the catch.—Fish caught during the patrol and hauling operations are hand-flushed with buckets of seawater to remove blood and slime. Fish brought on board during the patrol are immediately stored in the fish holds. Fish landed during the hauling operation are first temporarily stacked on the deck until the hauling in of the lines is completed when all the fish are stored in the fish holds and covered with crushed ice. The stored fish are arranged transversely in relation to the boat in several layers.

When not fishing or when the whole fishing operation is finished and the vessel is heading for the homeport, all the hatch covers of the fish holds are covered with a canvas sheet to lessen the penetration of heat inside the holds.

Composition of the catch.—The yellowfin tuna *(Neothunnus macropterus)* constitutes the bulk of catch of the tuna longline gear operated by the Pacific Fishing Development Company. In Table 1 is shown a comparative analysis of the catch of the **Dinia** and the **Nelly** by species. The yellowfins represent 62 percent of the total catch; spearfish, 22 percent; and sharks, 10 percent.

TABLE 1.—QUANTITATIVE AND QUALITATIVE ANALYSES OF THE CATCH OF THE *DINIA* AND *NELLY* BY FISHING GROUNDS.

Fishing Ground	Period of Fishing Operation	No. of Fishing Days	Average No. of Hooks Used Per Day	Catch Per 100 Hooks	Percentage Composition of Catch		
					Yellowfin	Spearfish	Shark
Central Sulu Sea	Aug. 14 to 15, 1950	2	600	5.25	76	13	11
Southern Sulu Sea	Aug. 16 to 17, 1950	2	600	3.67	52	43	5
Eastern Sulu Sea	Aug. 19, 1950	1	600	2.00	75	25	—
Northeastern Sulu Sea	Aug. 20 to 22, 1950	3	600	3.17	75	12	13
Northern Celebes Sea	Sept. 15, 17-22, 1950	7	420	6.86	81	19	—
Northwestern Celebes Sea	Sept. 22, 1950	1	480	4.17	50	10	40
Southern Sulu Sea	Sept. 24 to 25, 1950	2	480	2.50	58	14	28
Northwestern Sulu Sea ..	Sept. 27 to 28, 1950	2	480	1.04	40	40	20
Northeastern Sulu Sea ...	Sept. 30 to Oct. 1, 1950	2	480	3.44	40	24	36
China Sea (northwest of Lubang Island)	Oct. 6, 1950	1	480	1 65	37	26	37
Northern Celebes Sea	Oct. 16 to 21, 1950	6	450	4.52	86	14	—
South China Sea (west of Palawan)	Oct. 23 to 24, 1950	2	480	1.46	50	36	14
Southwestern Sulu Sea ...	Oct. 26 to 31, 1950	6	480	5.83	82	5	13
Western Sulu Sea	Nov 1 to 2, 1950	2	480	3.01	69	25	6
Mindoro Strait	Nov. 5, 1950	1	480	3.12	62	19	19
South China Sea (west of Palawan)	Mar. 20, 1951	1	540	9.08	78	10	12
South China Sea (southwest of Palawan)	Mar. 21 to April 1, 1951	10	540	3.14	41	35	24

The size of the yellowfins caught ranges from about 45 inches (115 centimeters) long with a weight of 20 to 25 kilograms to approximately 75 inches (190 centimeters) long with a weight of about 90 kilograms. Most of the yellowfins, however, have an average length of 63 inches (160 centimeters) and a weight of 53 kilograms.

Marketing of the catch.—All the catch of the **Dinia** and **Nelly** were sold in Manila in fresh condition.

The vessels would dock at the Royal Fish Landing in the city and the catch disposed of through a fish broker. The fish are taken out of the fish holds by means of a block and tackle. Each fish is tied with a piece of line at the tail (caudal peduncle) and raised to a lever scale balance hung just above the fish hold. The weight of the fish is taken and a tag with this information is attached. The fish is then brought to the cold storage plant. From there on the fish broker takes care of this disposal of the catch. He usually gets a 7 to 10 percent commission on the gross sales.

The fish are sold to the public at the following prices: yellowfins, ₱0.50 to ₱1.00 per kilogram; spearfish, ₱0.30 to ₱0.60 per kilogram; and sharks, ₱0.10 to ₱0.30 per kilogram. These big fish taken by the tuna longline vessels are not commonly seen in the fish markets of Manila. Because of the unfamiliarity of the majority of Manilans with them, it takes about a month or two to fully dispose of a trip's catch of the vessel.

THE FISHING GROUND

The success of the Pacific Fishing Development Company in operating the tuna longline gear in Philippine waters may be attributed in a large measure to the ability of the fishermen employed to locate good fishing grounds, especially those for yellowfins.

Description of fishing areas.—The fishing grounds where the **Nelly** and the **Dinia** operated are shown in Figure 12 and described briefly as follow:

1. **Sulu Sea**

(a) **Northeastern Sulu Sea.**—This is an area lying southwest of Panay Island and west of Negros Island. It is bounded on the north by Lat. 10°30'N, on the south by Lat. 8°38'N, on the east by Long. 122°18'E, and on the west by Long. 121°20'E.

(b) **Central and Southwestern Sulu Sea.**—This fishing ground includes about the whole of Sulu Sea between Palawan, Borneo and Sulu Archipelago. It is bounded on the north by Lat. 9°45'N, on the south by Lat. 6°30'N, on the east by Long. 121°00.5'E, and on the west by Long. 117°59'E.

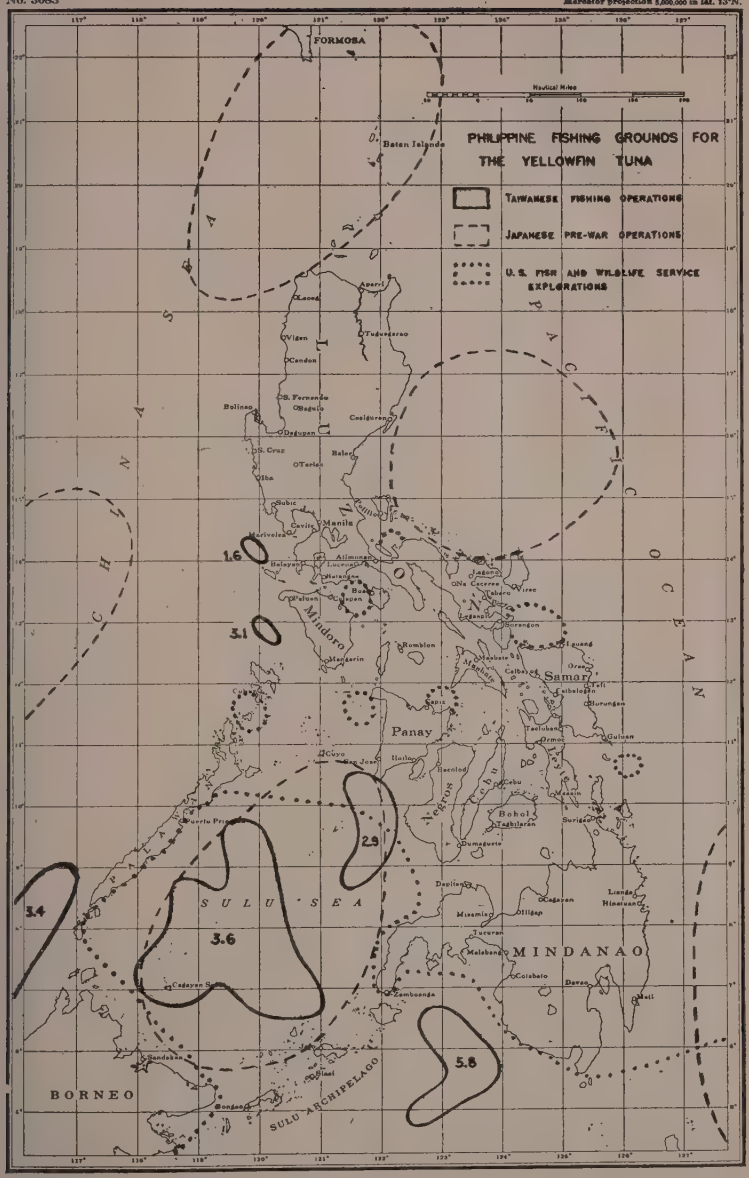

FIGURE 12. Yellowfin fishing grounds in the Philippines. Areas enclosed by heavy border lines are those fished by the **Dinia** and the **Nelly** employing Taiwanese fishermen. Number shown in each area indicates catch ratio per 100 hooks set.

2. **Celebes Sea.**—This fishing ground in Celebes Sea is south of Moro Gulf in Mindanao and is bounded on the north by Lat. 6°40'N, on the south by Lat. 4°47'N, on the east by Long. 123°58' E, and on the west by Long. 122°28'E.

3. **South China Sea.**—This fishing ground is a portion of the vast China Sea southwest of Palawan and northwest of Borneo and is bounded on the north by Lat. 9°02'N, on the south by Lat. 6°30'N, on the east by Long. 117°00'E, and on the west by Long. 114°00'E.

4. **Mindoro Strait.**—This fishing area is the section of Mindoro Strait southwest of Cape Calavite on Mindoro Island and is bounded on the north by Lat. 13°05'N, on the south by Lat. 12°36'N, on the east by Long. 120°20'E, and on the west by Long. 119°55'E.

5. **China Sea.**—The fishing ground here visited is a small area a few miles northwest of Lubang Island and only about 40 miles west of Corregidor Island. It is bounded on the north by Lat. 14°23'N, on the south by Lat. 13°58'N, on the east by Long. 120°10'E, and on the west by Long. 119°43'E.

ANALYSIS OF PRODUCTION

Catch per unit effort.—The two tuna longliners of the company caught an average of 12 tons of fish per trip of 21 days average duration and fishing for an average of 8 days (Table 2). The average catch per fishing day per boat is 1.44 tons. Based on a 12-man crew per vessel, the average catch per man per fishing day is 120 kilograms of fish. From Table 3 it is shown that the two vessels caught an average of 3.4 fish per hundred hooks set. This catch ratio of the over-all operation of the tuna longliners compares favorably with the 3 to 4 fish caught per hundred hooks in Japanese waters (Shapiro, 1948).

PRODUCTIVITY OF FISHING GROUNDS AS INFLUENCED BY OCEANOGRAPHIC FACTORS

The success of Japanese explorations and commercial fishing for tuna demonstrates the value of correlating oceanographic factors such as water current, temperature, tansparency, and bottom topography, with the location and abundance of the fish. Because of the well-established correlation between these factors and the presence or absence of fish, especially the tuna, as much oceanographic data as could be gathered with the little facility for such type of work were taken on the fishing grounds where the tuna longliners **Dinia** and **Nelly** obtained good catches of yellowfins. These data are presented in Table 4.

From an analysis of these oceanographic data, it is shown that the successful yellowfin catches were made mostly in waters where the depth ranges from about 550 to 2,200 fathoms (1,000

TABLE 2. — ANALYSES OF CATCH OF THE *DINIA* AND *NELLY* BY FISHING TRIPS

Name of Vessel	Fishing Trip No.	Inclusive Dates of Trips	No. of Days Out from Port	No. of Days Fishing	Total Approximate Catch	Average Catch Per Fishing Day	Average Catch Per Fishing Day Based on 12-Man Crew
					Metric Tons	Metric Tons	Metric Tons
M/B NELLY ..	1	Aug. 10 to 26, 1950	17	8	14	1.75	0.146
	2	Sept. 15 to Oct. 7, 1950	23	8	5	0.62	0.052
	3	Oct. 19 to Nov 6, 1950	19	11	16	1.45	0.121
	4	Nov. 20 to Dec. 11, 1950	22	7	12	1.71	0.142
	5	Dec. 27, 1950 to Jan. 21, 1951	26	7	14	2.00	0.167
	6	Feb. 14 to Mar. 9, 1951	24	9	12	1.33	0.111
	7	Mar. 15 to April 5, 1951	22	11	12	1.09	0.091
M/B DINIA ...	1	Sept. 10 to 28, 1950	19	7	13	1.86	0.155
	2	Oct. 12 to 27, 1950	16	6	7	1.16	0.097
Average			21	8	12	1.44	0.120

to 4,000 meters); where the temperature ranges from 28ºC to 29ºC at the surface and 27ºC to 28ºC at the subsurface layer of about 165 feet (50meters); and where the salinity ranges from 33 to 34 parts per thousand.

TABLE 3. PRODUCTIVITY OF TUNA FISHING GROUNDS BASED ON CATCH PER UNIT SET OF THE *DINIA* AND *NELLY*.

Fishing Ground	No. of Hooks Used	No. of Fish Caught	Catch Per 100 Hooks
SULU SEA			
a. Northeastern Sulu Sea	3,360	97	2.9
b. Central and Southwestern Sulu Sea	8,610	297	3.6
CELEBES SEA			
a. Northern Celebes Sea, south of Moro Gulff	6,020	349	5.8
CHINA SEA			
a. South China Sea, southwest of Palawan	6,900	235	3.4
b. East China Sea, northwest of Lubang Island	480	8	1.6
MINDORO STRAIT			
a. Northwestern Mindoro Strait	480	15	3.1

TABLE 4.—GENERAL OCEANOGRAPHIC DATA OF AREAS OF OPERATIONS OF THE *NELLY* AND *DINIA*

Fishing Ground	Approximate Area (Sq. miles)	Average Depth (fathoms)	Ave. Current Drift (Knots)	
			NE Monsoon	SW Monsoon
Sulu Sea				
a. Northeastern Sulu Sea	3,800	1,850	< 0.5	< 0.5
b. Central and Southwestern Sulu Sea	19,530	1,600	> 0.5	< 0.5
Celebes Sea				
a. Northern Celebes Sea, south of Moro Gulf	5,150	2,350	< 0.5	> 0.5
China Sea				
a. South China Sea, southwest of Palawan	11,880	770	> 0.5	< 0.5
b. East China Sea, northwest of Lubang Island	300	220	> 0.5	< 0.5
Mindoro Strait				
a. Northwestern Mindoro Strait	300	600	< 0.5	< 0.5

Fishing Ground	Water Temperature (Centigrade)			
	Surface		Subsurface (165 feet)	
	NE Monsoon	SW Monsoon	NE Monsoon	SW Monsoon
Sulu Sea				
a. Northeastern Sulu Sea	27 64	29.40	25.70	28.40
b. Central and Southwestern Sulu Sea	28.95	29.33	28.03	27.90
Celebes Sea				
a. Northern Celebes Sea, south of Moro Gulf	28.41	28.56	26.66	27.02
China Sea				
a. South China Sea, southwest of Palawan	27.83	29.32	26.55	28.41
b. East China Sea, northwest of Lubang Island	28.97	29.14	28 04	28.30
Mindoro Strait				
a. Northwestern Mindoro Strait	28.66	29.52	27.90	28.82

Fishing Ground	Salinity (°/oo)			
	Surface		Subsurface (165 feet)	
	NE Monsoon	SW Monsoon	NE Monsoon	SW Monsoon
Sulu Sea				
a. Northeastern Sulu Sea	34.21	33 82	34.27	34.07
b. Central and Southwestern Sulu Sea	33.51	33.69	33 98	34.08
Celebes Sea				
a. Northern Celebes Sea, south of Moro Gulf	34.11	34.09	34.36	34.50
China Sea				
a. South China Sea, southwest of Palawan	34.48	32.31	33.98	33.12
b. East China Sea, northwest of Lubang Island	33.48	33.44	34.33	34.11
Mindoro Strait				
a. Northwestern Mindoro Strait	33.55	33.10	34.12	33.67

COST OF OPERATION OF TUNA LONGLINERS

The following is an analysis of the average expense per trip per boat of the **Nelly** and the **Dinia**:

Salaries and allowances of Taiwanese fisherman	₱ 970.00
Salaries and allowances of Filipino crew (including apprentice fisheries students)	735.00
Crushed ice, 200 blocks of 300 lbs. each at ₱2.10	420.00
Bunker coil, 28 drums of 53 gallons capacity each	

at ₱11.00 per drum	308.00
Lubricating oil, 2 drums at ₱60.00	120.00
Bangos bait, 4,000 fish at ₱0.20	800.00
Food and provisions of crew	350.00
Rubber-sheave lining replacements for the line hauler	6.00
Fishing gear replacements	50.00
Maintenance cost, including repairs, on the vessel	50.00
Maintenance cost, including repairs, on the engine	150.00
Berthing fee, average of 10 days	5.00
Customs fees	20.00
Taxes	450.00
Miscellaneous expenses	100.00
TOTAL	₱4,534.00

DIFFICULTIES MET BY TUNA LONGLINERS

From the standpoint of production the operation of the **Dinia** and the **Nelly** by the Pacific Development Company is considered fairly successful. The Company, however, failed to make a financial success of the venture and ceased operation after nine months because of the difficulties it encountered in the disposal of the catch. Although the tuna is considered a high class fish, the Company discovered that there was only a very limited market for the fresh tuna.

The majority of the people, especially those living in the Manila area, are not familiar with the fish and are even afraid to eat them. Since they must be sold in small slices their identity is lost and the buyers think they may be shark meat. Because of this poor receptability, the Company had to sell its catch at a low price.

DEVELOPMENT OF A TUNA INDUSTRY

Records of past and present explorations show that the yellowfin tuna is widely distributed in Philippine waters and in adjacent areas such as the South China Sea and the Western Pacific Ocean. This fish is caught in abundance throughout the year by the tuna longline gear and in fish corrals constructed on the edges of steep depressions close to shores. It is in the employment of the tuna longline, however, that the yellowfin can have a real basis for industrial development in the Philippines. The light meat of this species is the type suitable for canning.

In the light of the experience of the Pacific Fishing Development Company, the extensive tuna resources of our deep seas could be successfully exploited by the establishment of a large

industrial organization to handle the catch. The difficulty met by this Company could be eliminated through "big" business methods. This means the organization of a fleet of tuna longline fishing vessels for year-round operation in Philippine and surrounding waters, a shore installation for servicing such a fleet, and the establishment of a central canning plant to absorb the catch.

Based on an average catch of 12 tons of fish per month per vessel, 60 percent of which is tuna, a fleet of 10 tuna longline vessels operating from Manila can supply a tuna cannery to produce no less than 2,600 cases of half-pound cans of tuna monthly. The tuna catch which could not be sold in the Philippines in fresh condition will not only find a ready local market when canned but will also help save our dollars by cutting down on imports of canned fish products and provide employment for factory workers and fishermen.

The enterprise may be organized by private organizations which must be properly financed and well equipped with management skill peculiar to this business. Such private capital could be encouraged and protected from initial set-backs by government subsidy.

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RIGGING OF MOTOR VESSELS AS BASNIGAN

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INTRODUCTION

The **basnigan**[1] is a type of lift netter provided with powerful lights for the catching of pelagic species such as the herrings, sardines, anchovies, mackerels, bonitos, squids and shrimps. The development of this indigenous gear and the recent successful rigging of larger motor vessels as lift netters is considered a great landmark in Philippine fishing history. With this gear Filipino fishermen can now reach offshore pelagic fishing grounds and bring their catch home preserved in ice. It was rapidly adopted by fishermen throughout the Philippines within the last three years and has largely displaced the once popular **sapiaoan** or **scoop netter** (sometimes called **round haul seine** (Umali, 1950). Of the total catch of sapiaoan and basnigan during the last few years before World War II, about 80 percent were made by sapiaoan and the remaining 20 percent by basnigan. At present more pelagic fish are caught by basnigan than by sapiaoan. In 1950 about 40 percent of the catch of pelagic fish by all fishing gear were taken by basnigan. This popularity is shown by the rapid increase in the number of registered lift netters from 1946 to 1950 (Table 1). Low initial cost,

TABLE 1.—NUMBER OF REGISTERED BASNIGAN AND SAPIAOAN OF OVER 3 TONS GROSS

YEAR	BASNIGAN	SAPIAOAN
1946	142	101
1947	192	218
1948	168	63
1949	242	95
1950	333	82

simple operation and the few men required are the main reasons for the rapid ascendancy of the basnigan over the sapiaoan.

1/ A Visayan word for a vessel used for fishing with **basnig**, a type of lift net.

THE TYPICAL BASNIGAN AND ITS METHOD OF FISHING

The typical basnigan is an outriggered type of sailing boat called **parao** in the Visayan dialect (Figures 1 and 2). This boat

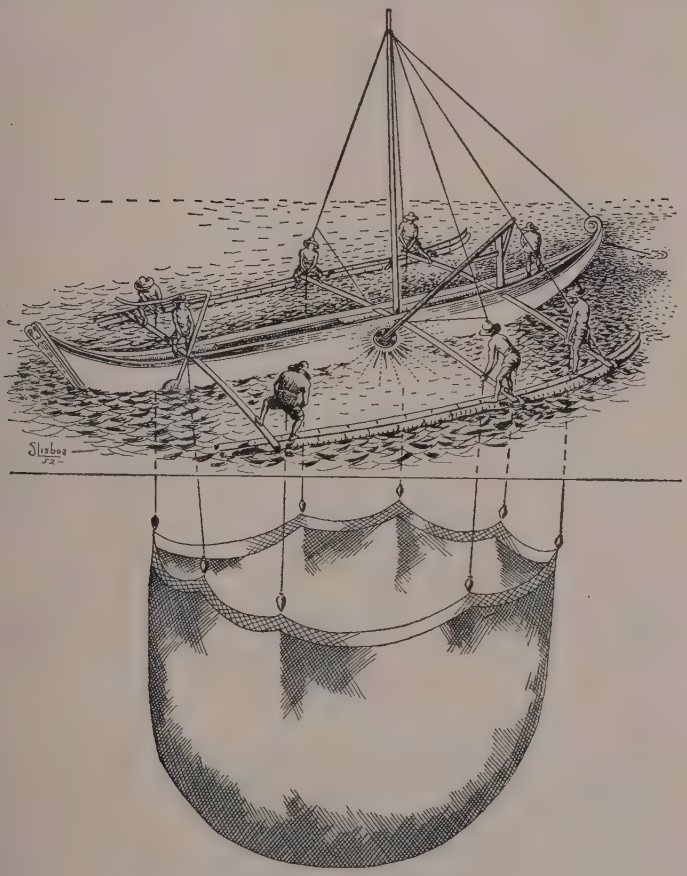

FIGURE 1. Visayan type of basnigan. The sails, peak and boom are not shown.

is a specially constructed dug-out to which side plankings, waterways and bulwarks are added to increase its capacity. It is provided with a curved stem at the bow and a twin horn fitted with a transom at the stern which give the boat a crescent-shaped outboard profile. Three outrigger beams extend out from both sides

of the boat and are held firm across the waterways by means of galvanized iron wires tightened from a lower beam fastened to grooves in the dugout. At the ends of the outrigger beams bamboo or wooden floats are tied parallel to the hull of the boat. A mast is erected a little forward from midship to which a triangular jib sail and a trapezoidal main sail are rigged in a manner similar to those of a schooner. Stays and shrouds are distributed from the top eyeband of the mast to the stem and to all points of intersection

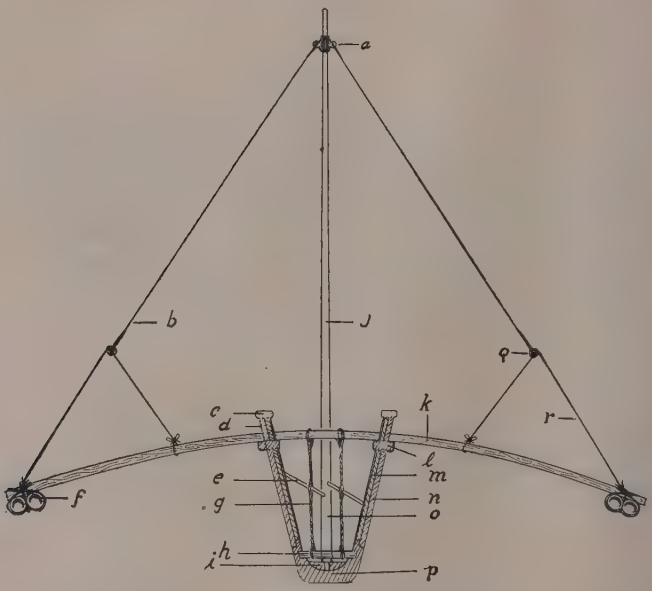

FIGURE 2. Cross section of Visayan type of basnigan showing **a**, eyeband; **b**, shroud; **c**, gunwale; **d**, bulwark; **e**, clamp stick; **f**, bamboo float; **g**, wire clamp; **h**, lower clamp beam; **i**, mast socket; **j**, mast; **k**, outrigger beam; **l**, waterways; **m**, body frame; **n**, plankings; **o**, mast, lower part; **p**, dugout hull; **q**, dead eye; and **r**, lanyard.

of the floats and the outrigger beams. The shrouds securing the forward part of the floats are made more taut than the rest to prevent the floats from plowing in the water. A detachable paddle-shaped rudder is seated on a concave post attached to the outrigger close to the starboard side.

The fish are attracted to the boat by means of powerful surface lights installed on the sides of the vessel. When a large number of fish has concentrated below the anchored boat, a haul is made. All lights at the midsection of the vessel are put out and

the **basnig** or lift net is then paid out from this section. The net is usually of rectangular box shape and is spread out directly below the boat by means of the outriggers. When set in the water it resembles an inverted rectangular mosquito net. In shooting the net the conditions of currents and winds are considered. The setting process temporarily disorganizes the school of fish. To regroup the fish, all the lights are turned on for a short time after setting the net. Then they are turned off one by one until only one lighted lamp in the middle section of the boat remains. This lamp is hooded to further focus the light and concentrate the fish along with it. In the semi-darkness the net is quickly lifted by means of pull ropes to the surface and maneuvered to one side of the vessel where the fish are impounded and finally brailed out. A series of such hauls are made during a night's fishing, the number of hauls depending upon the duration of darkness and the abundance of fish.

PLACE AND DATE OF ORIGIN OF EARLY BASNIGAN

The first basnigan outfits were constructed sometime in 1936 in the coastal towns bordering the islands of northwestern Negros and northwestern Panay in the Visayas in the Central Philippines. Its development, however, appears to have centered in the barrio of Punta Buri, Tagobanhan Island, Municipality of Ajuy, Iloilo Province. The basnigan outfit came about as an alternative to the costly and cumbersome sapiaoan outfit. At that time a sapiaoan unit cost about ₱2,000 and the basnigan about ₱500. The new gear enabled Visayan fishermen with modest capital to fish for pelagic species more effectively and with less men than the sapiaoan. It easily became popular and from the Visayas it spread throughout the Philippines. The most notable shift from sapiaoan to basnigan was observed in Manila Bay where towards the end of 1950 the latter has almost completely replaced the former.

MODIFICATION OF THE EARLY BASNIGAN

The original basnigan was a small outriggered boat about 25 feet in length. It was manned by six fishermen and used a single kerosene mantle lamp of about 1,000-candle power intensity. The net had a perimeter of about 80 feet and was made of sinamay or abaca cloth. This was later superseded by cotton nets made of Nos. 1, 2 and 3.[2]

The basnigan were propelled by sail or towed in groups by a hired motor launch. Some operators of large outfits later found it necessary to use individual motor propulsion. A typical large

2 The size of cotton netting is indicated by Philippine net merchants in their catalogues by numbers with corresponding samples. All the nettings are made of cotton twine. No. 1 is made of cotton twine of 6 threads with 22 meshes to a foot. No. 2 is made of cotton twine No. 6 with 24 meshes per foot. No. 3 is made of cotton twine No. 6 with 28 meshes per foot.

utriggered basnigan now in operation has a capacity of about 16 gross tons, propelled by a 30 to 60 h.p. gasoline engine or by a Graymarine Diesel engine of 225 h.p., and equipped with an electric power unit to furnish the light for fishing. Electric lighting began to replace the kerosene mantle lamps even before the basnigan started to use individual motor propoulsion. The large boats started to install permanent housing for the crew and the engine and thus the open parao began to be provided with a permanent deck and a fish hold.

In the original basnigan the size of the net that could be used was limited by the length of the outrigger beams. In the Manila Bay basnigan this limitation was partly overcome by using "horns" instead of outriggers to spread the net (Figure 3). Three pairs of

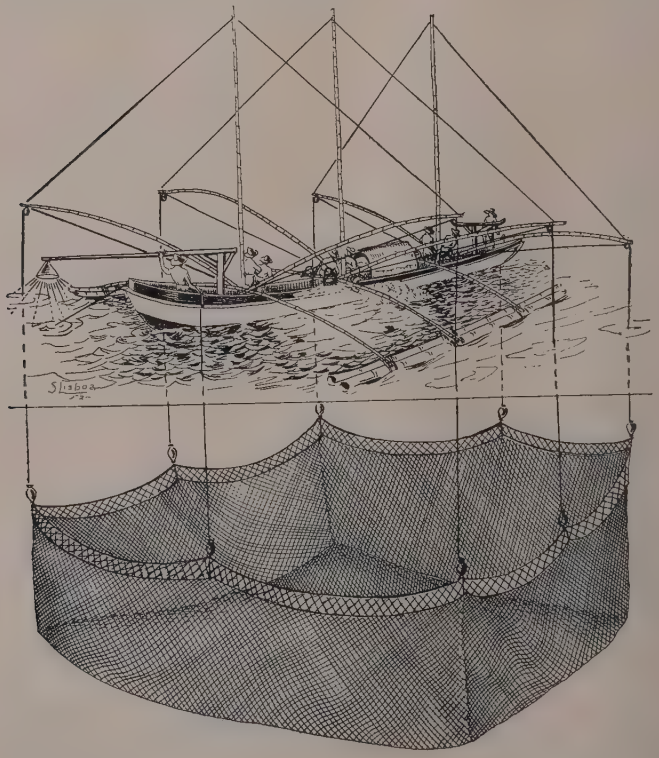

FIGURE 3. Manila Bay type of basnigan equipped with electric generator for lighting and bamboo "horns" for operating net.

detachable bamboo horns, each pair supported from a mast, are used for this purpose. This improvement over the original basnigan made it possible to use a large net on a proportionally small vessel. Thus, a net with a perimeter of about 430 feet used on a Visayan basnigan 90 feet long can be efficiently operated on an 80-foot Manila Bay lift netter.

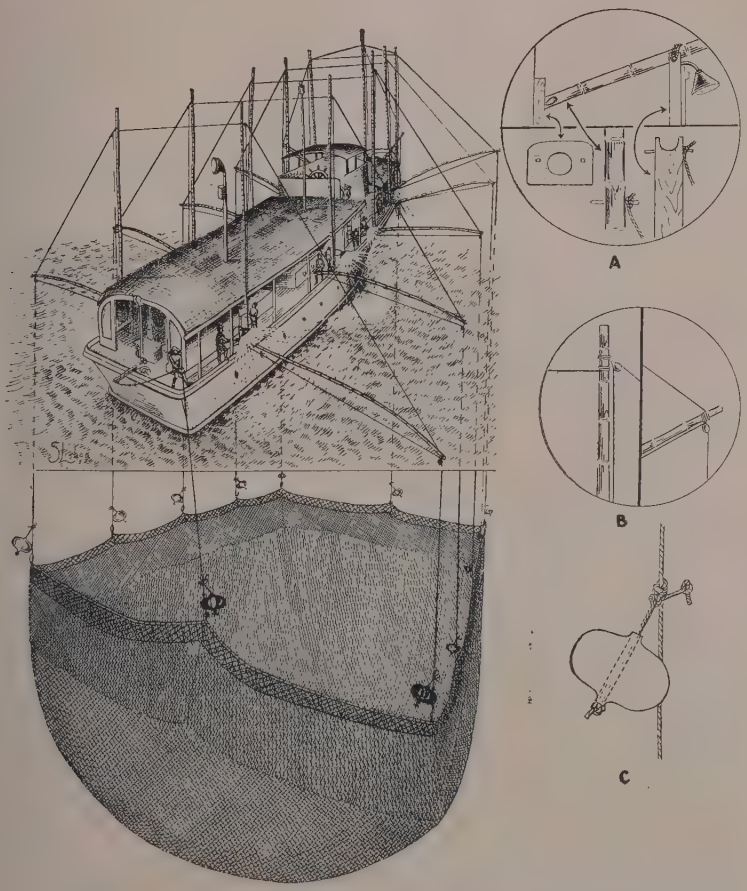

FIGURE 4. PT (Patrol Torpedo Boat) rigged as basnigan. **A**, details of attachment for the bamboo "horn" base; **B**, bamboo "horn" end attachment; **C**, lead sinkers used on rim of net.

MOTOR LAUNCHES FOR BASNIGAN

The already well-developed parao basnigan underwent further revolutionary changes toward the end of 1949 when Manila Bay fishermen, especially in the fishing towns of Malabon and Navotas, started to rig motor launches as basnigan (Figure 4). Thus, the use of boats without the traditional outriggers began.

The rigging of motor vessels was encouraged by several factors; namely, (1) the desire of Manila Bay fishermen to extend operation to distant fishing grounds and to improve methods of handling and preservation of the catch; (2) the existence of large number of surplus vessels left by the United States Armed Forces in the Philippines at the termination of the last World War; (3) the rapid decline in the trawl fishing industry resulting in the reduced operation of many trawling vessels; and (4) the relentless and apparently successful drive of the government against illegal fishing forcing operators of many fish carriers to return to legitimate operations.

At present a craze in pelagic fishing with the use of basnigan exists in many fishing centers of the Philippines. Many fast lift netters in Manila Bay can reach as far as Nasugbu and Balayan Bay in Batangas Province or the Simo Banks west of Lubang Island during one night's fishing and return to Manila early the following morning to sell their catch. The motor launch basnigan, however, are able to fish farther and longer because they can keep their catch in iced condition fresh for several days.

Manila Bay fishermen use assorted types of motor vessels as basnigan. The more common types used are the sampan type, the PT (patrol torpedo boat), the SC (submarine chaser), and the YMS (motor mine sweeper). The specifications of these boats are shown in Table 2. These motor vessels range in size from the 70-foot sampan type to the 136-foot YMS.

The many surplus vessels now used for trawling are mostly powered with highspeed Diesel engines and are therefore less suitable for this purpose than for basnigan fishing which does not require continuous heavy work. Many large motor vessels formerly operated exclusively as fish carriers are also generally powered with highspeed Diesel engines. When converted into basnigan, these boats increase their usefulness by combining in one vessel the functions of a fish carrier and a fish catcher. Some trawlers converted into basnigan usually carry a set of trawl nets and use them when the lift net could not be used due to strong current or inclement weather.

The large and fast motor launches converted into basnigan enable Manila Bay fishermen to increase their radius of operation and reach as far as the fishing grounds in eastern and western Palawan which could not be reached by the large parao basnigan.

TABLE 2. — SPECIFICATIONS OF FOUR TYPES OF MOTOR VESSELS COMMONLY USED AS BASNIGAN OR LIFT NETTERS

Characteristic	TYPES OF MOTOR VESSELS (U.S. NAVY NOMENCLATURE)			
	PT Motor Torpedo Boat	Trawlers Japanese Sampan Type	SC Submarine Chaser	YMS Motor Mine Sweeper
Length (feet)	80 to 85	70 to 100	110	136
Beam (feet)	20 to 22	16 to 20	18	24.6
Draft (feet)	5.2	6 to 8	5	6
Displacement (tons)	49	50 to 80	85	207
Fuel Capacity (gallons)	3,000	1,500 to 3,000	4,600	
Endurance (miles)	625 at 18 knots	750 to 1,500	2,300	2,200 at 9/5 knots
Speed (Knots)	40	7 to 10	16 to 22	14.5
Hull	wood	wood	wood	wood
Propulsion	Three 1,200 h.p gasoline engine	80-180 b.h.p. Semi-diesel engine	1,000 h.p.	Two 8-cylinder 500 h.p. GM Diesel 2 series
Auxiliaries			2 electric generators	One 8-cylinder 500 h.p. GM Diesel; Two diesel generators 1-30KW and 1-60KW 120 Volts DC

As late as 1949, the rigging of motor launches as lift netters had neither been thought of nor considered possible as it should be recalled that the operation of the lift net was originally dependent on the use of outriggers. The net was spread out to the extent of the length of the boat and the span of the outriggers. In the Visayan basnigan, the net is raised by means of pull ropes held by fishermen stationed directly on the floats of the outriggers. In Lemery, Batangas Province, the basnigan is operated in the same way as in the Visayas but in order to spread out the net wider, the outrigger beams are made disproportionately long. This makes the basnigan unwieldy and gives it the appearance of a long-legged water strider. Then Manila Bay fishermen introduced the use of detachable bamboo horns to spread the nets. Each pair of horns is held in place by rope stays and shrouds supported from an auxiliary bamboo or wooden mast. These horns are provided with single block pulleys at the end through which the pull ropes of the net are hauled in from the boat. The fishermen no longer have to stay on he outriggers to do this. By this arrangement,

the net in Manila Bay basnigan is spread out to the extent of the length of the horns and no longer of the outrigger beams. The net is spread wider than in the Visayan basnigan because the horns can be made to project out further than the outriggers. This proved to be a very significant change, for not only did the use of horns increase the fishing capacity of small basnigan but it also made possible the handling of lift nets on motor vessels which have no outriggers. Figure 5 shows the relative spread of the net in the Viayan basnigan, Manila Bay outriggered basnigan, and motor launch basnigan. This figure also shows how the horns are laid out to give the maximum spread to the net.

MOTOR LAUNCH BASNIGAN VERSUS PARAO BASNIGAN

There are many obvious advantages of motor launch basnigan over the parao type. The fish carrying capacity of the ordinary outriggered boats is much less than that of motor vessels which can carry a load of from 20 to 40 tons. Motor vessels also have much greater fishing efficiency due to their longer cruising range, better accommodation for the crew-fishermen and greater seaworthiness. These vessels have spacious and well-insulated fish holds which make possible better handling and preservation of the catch than in the ordinary parao basnigan. The catch of a parao lift netter is dumped into the hold of the boat and kept there without refrigeration for several hours until dawn when the boat reaches port. During this period heat is generated in the thick pile of fish promoting rapid decomposition especially in the deeper layers. At the anchorage the fish are unloaded and iced for the first time in preparation for the retail market.

MODIFICATIONS IN FISHING EQUIPMENT AND OPERATION OF MOTOR LAUNCH BASNIGAN

In spite of the great changes in the boats used as basnigan, the net retains essentially its rectangular box-like shape. In some nets the bottom part may be made semi-spherical.

The operation of the basnig on board motor launches remains essentially the same as in the earlier types. Special precautions are however taken to prevent the net from fouling with the propeller and the rudder during fishing operation. In some boats the net is set a little forward of the propeller. In others the net is evenly spread below the bow and stern and is cleared of the propeller and rudder by pushing the rim down with a bamboo pole provided with a Y-shaped yoke at the tip.

The lighting system used for attracting the fish has also undergone considerable improvement, the trend being toward more and more powerful illumination. As has been stated, most of the new types of basnigan use electric lighting to attract the fish. The generators used range in capacity from 10 to 30 kilowatts. As many

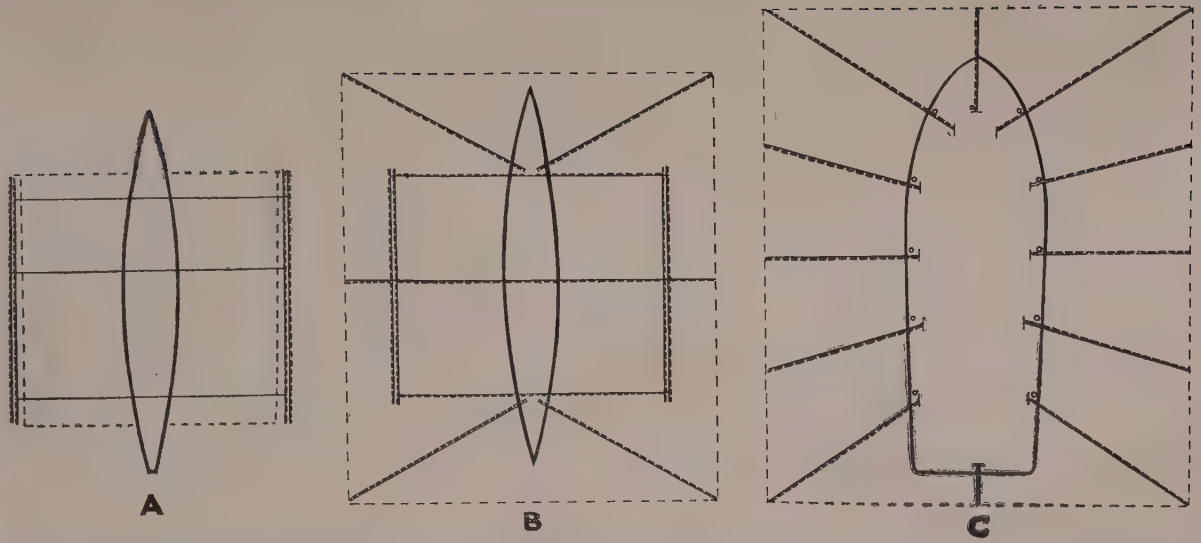

FIGURE 5. Diagrammatic top view of three types of lift netters illustrating methods of spreading nets. **A**, Visayan type of basnigan; **B**, Manila Bay type of basnigan; C, PT Boat (motor launch) basnigan. Light dotted lines indicate mouthrope framings; single heavy dotted lines are bamboo "horns", double heavy dotted lines are outrigger floats.

as a dozen 1,500-watt electric light bulbs may be installed along both sides of the boat. The use of electric lamps was found to be more convenient and economical than the kerosene lamps which were used exclusively several years ago. Electric units installed on board basnigan are often provided with shock absorbers to minimize vibrations that are liable to be transmitted to the hull by the engine. This precaution is taken because most Filipino fishermen believe that such vibrations scare the fish away.

Some submarine chasers used as lift-netters are equipped with two right-handed Japanese 2-cycle semi-Diesel engines of the direct reversible type. These engines are so constructed that the individual cylinders could be re-installed in the reverse position without affecting the original reversibility of the engines. This characteristic is taken advantage of by basnigan operators to produce an arrangement which ultimately may be considered as twin engine. In the starboard engine the original feature is retained, while in the port engine the position of the cylinders is reversed. The two engines are installed in parallel, their controls facing each other or to the center line of the boat. The port engine is provided with a left-handed propeller.

This engine arrangement is resorted to by basnigan operators to produce greater speed on a relatively smaller brake horsepower and lower fuel consumption than a single engine of greater horsepower. Engines of 120 h.p. have been used for this purpose.

Since the length of the bamboo horns determines the maximum size of the net used in Manila Bay basnigan, the longest bamboo poles available are used. In motor launch basnigan there may be four or more horns on each side of the vessel, each horn being held in place by stays and shrouds supported by an auxiliary bamboo mast. These horns and auxiliary masts are detachable and are set in place at the fishing ground during fishing operations or when in port to dry the nets. These motor vessels are provided with a short bow sprit horn and, occasionally, a stern horn, to help spread the net evenly and maneuver it to the hauling and brailing side. These horns are usually about one half the length of the side horns.

SIZE LIMIT OF BASNIGAN

From the preceding discussions it is noted that the consistent direction of improvement of the basnigan has been toward increasing size of the boat and of the net and the lighting power. Originally conceived as a protest by poor Visayan fishermen against the expensive sapiaoan, it has developed into an elaborate and highly mechanized affair that now costs more than the sapiaoan itself. The 110-foot or 136-foot motor basnigan is a far cry from the original 30-foot parao lift netter. The modern vessel costs from P50,000 to P120,000 whereas the parao basnigan of the 1936 class would at present cost about P2,000.

Many of the basnigan operators in Malabon and Navotas are of the opinion that the 110-foot submarine chaser so far appears to be the best size of boat as a lift netter. The suitability of using larger vessels such as the 136-foot YMS, is still being observed by basnigan owners in Malabon. One such boat is now operating in Palawan waters. It is believed that large vessels such as this may be operated profitably during the height of the fishing season for pelagic species but may be too costly to operate for the relatively small catch during the rest of the year. What then is the size of the biggest boats that could be efficiently and economically used as a basnigan? From the mechanical standpoint there appears to be no major difficulties that would limit the size of the boat or the net for basnigan. From the economic angle, however, the cost of the outfit and its maintenance in relation to catch are factors that are likely to limit future lift netters to a certain size range.

POSSIBLE IMPROVEMENTS

Mechanization in the handling of nets. — The handling of the pull ropes to lift the net out of the water is still done manually even in the latest types of basnigan. This phase of the operation, however, could be mechanized by using a multiple power winch (gindy) or several independent winches. By means of clutches and brakes each drum in the multiple power winch could be operated independently of the others. Power for this purpose could be supplied by the electric generating unit.

Improvement of the horns. — The size of the net in the modern basnigan is limited by the length of the bamboo horns used. The limitation in size and durability of bamboo horns may be remedied by substituting light wooden booms for bamboo poles. These booms should be provided with accessory goosenecks, eyebands and pulleys.

Fish detector and depth recorder. — Fish drawn to the light of the basnigan are not generally seen from the boat since they tend to stay deep down. To detect the presence of fish Filipino head fishermen in basnigan outfits often employ several fairly reliable methods. The presence of the phosphorescence in the water or of fish beads or bubbles on the surface of the sea and the vibrations felt by the hands from a piece of weighted string lowered in the water, are some of the more commonly used fish indicators. Numerous bubbles or sharp, frequent strumming on the string are said to indicate not only the presence of fish but also their approximate quantity. High percentage of reliability is claimed for these methods of fish detection. They cannot, however, tell the fishermen of the presence of obstructions at the bottom that may endanger the net during operation.

A modern device that could be used to increase the fishing efficiency of basnigan is the Bendix Supersonic-Depth Recorder. While the main use of this apparatus is to record automatically the depth of the water over which the boat runs, it can also help detect the presence, kind, and quantity of fish directly under the boat and help determine the nature of the sea bottom. It is, therefore, a reliable aid in avoiding obstructions and loss of fishing paraphernalia. At present this instrument is extensively used in the United States by many fishermen as an aid in fishing as well as in navigation.

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"GULAMAN DAGAT" AS SUPPLEMENTARY FEED FOR BAÑGOS

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The bañgos[1] pond industry of the Philippines, although already well-developed as compared with the same industry in other countries of the Indo-Pacific area, has still two main problems to solve; namely, to increase the area of the pond system and to increase production per unit of the operating area. The decline in the inshore and trawl fisheries of the Philippines as a result of the combined evils of dynamite fishing and over-fishing has led to an increasing dependence on artificially raised fish such as the bañgos.

To produce more fish in bañgos ponds various cultural practices have been resorted to by fishpond operators, such as the improved technique of culturing the basic food of this fish, rotation of the different production units of a fishpond, and supplementing pond-produced **lumut** or filamentous algae *(Enteromorpha, Cladophora, Chaetomorpha* sp.) with artificial feeds such as rice bran, fermented dry water hyacinth *(Eichornia crassipes),* rice straw, and **digman** *(Najas, Ruppia* sp.). The most promising of the substitute or supplementary feeds is gulaman dagat *(Gracilaria confervoides),* a common seaweed found in great abundance in Manila Bay.

The utilization of gulaman dagat as supplementary feed for bañgos in the well-developed fishpond units in the province of Rizal, Bulacan, Pampanga, and Bataan is the subject of the present investigation.

BIOLOGICAL ASPECTS OF GULAMAN DAGAT

Identification and description.—Gulaman dagat is a red alga of the family Gracilariaceae, order Gigantinales. The plant varies in length from a few inches to about 34 inches. It also varies in coarseness and in the amount of branching, from coarse, slightly branched to fine, slender, and much-branched. The following description of the species by Hoyt (1918) tallies with that of the Philippine *Gracilaria:*

"Frond elangated, terete, vaguely laterally branched, flagelliform, 0.5 to 3mm. diameter, 14 cm. to 1 m. long, branches elong-

1/ Tagalog name for milkfish, **Chanos chanos** (Forskal)

ated. subundivided, branchlets subsecund, slightly attenuated at both ends, filiform, more or less numerous; tetrasporangia numerous, immersed among the cortical cells of short filiform branchlets; cystocarps prominent, hemispherical, numerous on all sides of branches and elongated branchlets, substance fleshy-cartilaginous, color light to dark red."

Gracilaria have been observed to undergo very characteristic color changes from living to dead status. The living *Gracilaria* are dark brownish-red in color when young, changing to light cream color when old. They are also of dark color when growing in deeper water, but are of light green color in shallower water about a foot deep. The fronds turn violet upon exposure to the sun, then to pale creamy-white to almost colorless on prolonged exposure.

Seasonal geographical distribution.—In Manila Bay gulaman dagat appears in great abundance from November at the turn of the monsoon through June when the southwest wind sets in. The peak of abundance, however, is during the months of March, April, and May. In a biological survey conducted by the authors during the months of February and March, 1951, gulaman dagat was found growing on the extensive tidal flats bordering Manila Bay, especially near the town of Navotas, in Binuangan, Obando, Bulacan Province, in Batag at the mouth of Guagua River in Pampanga Province to as far as Puerto Rivas in Bataan Province. It was also found growing at Vitas, Isla de Balut, near North Harbor in the City of Manila. No gulaman dagat was observed south of Manila from Las Piñas to Cavite, although people interviewed in these places stated that this seaweed used to appear along the beaches in large quantities in previous years during squally days. It was, however, reported to grow along the coastal waters of the town of Rosario, Cavite prvince, during the onset of the Southwest wind.

Gracilaria has been reported by fieldmen of the Bureau of Fisheries in Cagayan, Lingayen Gulf, along the coast of Quezon Bay, Iloilo, Samar, and in Zamboanga and Basilan waters. Seale (1911) appears to be the first to report its presence in Philippine waters. *Gracilaria* grows in both warm and temperate waters and is of world-wide distribution, being reported by Hoyt (1918) to grow in Maine on the eastern seaboard of the United States, and in Japan, Australia and India.

In view of the growing imporance of gulaman dagat as a supplementary feed for cultured fish, a thorough survey of *Gracilaria*- producing areas in the Philippines outside Manila Bay should be made to determine their extent and accessibility to existing and potential fishpond areas.

Ecology.—Gulaman dagat grows in water shallow enough to be exposed at low tide (Figure 1a) to as deep as eight feet. The most favorable zone of growth, however, appears to be in waist-deep water. In the *Gracilaria* areas surveyed, the water ranged in salinity from 2 to 18 p.p.m., the temperature from 27°C to 33°C, and the pH from 7.6 to 8.5. The growing areas of *Gracilaria* have a sandy and fairly firm bottom mixed with mud, fine sand and shells. Attachment is made by a peculiar symbiotic arrangement with a species of Polychaete worm of the genus *Nereis* which has the habit of constructing a parchment-like tube sunk more or less perpendicularly into the sandy bottom. The seaweed is cemented around the top opening of this tube which barely projects above the level of the soil. The seaweed is probably attached to the tube by the worm itself. This seaweed conceals the worm in his place of retreat, and probably serves also to lure the food of the worm. By this arrangement the seaweed is afforded a sufficient anchorage as it does not develop any root system for independent attachment to the substratum. When detached from its mooring, the seaweed drifts about close to the bottom through wave action. It is weakly anchored and is therefore easily scraped from the bottom by hand or foot and may thus be gathered in big matted heaps. The waves often detach this weakly anchored seaweed. During squally days, especially when the southwest wind sets in, large quantities of gulaman dagat are cut loose from their moorings and thrown high along the beaches. These may pile up to as much as one or two

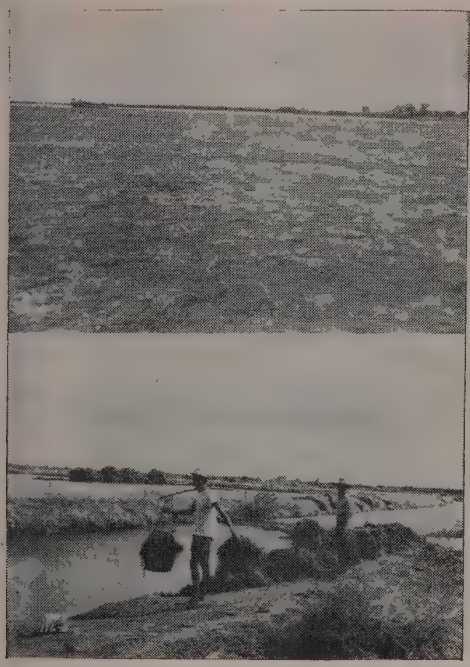

FIG. 1. (a) Gulaman dagat in shallow water; (b) Seaweeds delivered on dike of pond.

feet in thickness. These thick piles of seaweeds decompose in the summer heat and emit a foul odor.

Gulaman dagat growing in shallow water one or two feet deep are often "grown over" with *Enteromorpha* and **Cladophora.** These filamentous green algae are cultured in brackish water ponds together with *Chaetomorpha* as the basis of the primary food of growing bangos. The thickness of growth of these green algae over the field of gulaman dagat was observed to decrease with increase in depth of water.

EARLY USES OF GULAMAN DAGAT

The earliest use of gulaman dagat in the Manila Bay area was as human food in the form of agar-agar extract. De Leon (1947) confirmed the long-established local reputation of *Gracilaria* that agar-agar of good quality could be manufactured from it. He found the yield in organic and inorganic matter of gulaman dagat as follows: t

Nitrogen-free extract	74.60%
Moisture	16.00%
Ash	4.00%
Protein (n x 6.25)	4.20%
Ether extract	1.20%

To extract agar-agar, the seaweed is washed and bleached in the sun for several days until a white and odorless product is obtained. When ready for market it resembles rice noodles (miki). During the critical years of the Japanese occupation of the Philippines gulaman dagat was extensively used by famished inhabitants along the shores of Manila Bay for food as salad or vegetable and must have helped save many lives from death by starvation.

GULAMAN DAGAT AS FEED FOR BANGOS

The use of gulaman dagat as supplementary feed for bangos started as early as 1937, but extensive application actually started only during the war years. At present practically all fishponds in the provinces of Bulacan, Rizal and Pampanga close to Manila Bay use gulaman dagat as a substitute or supplementary feed for bangos. The nearness of the *Gracilaria* grounds in Manila Bay to the highly-developed fishpond systems of Bulacan and Rizal is an important factor which led to this extensive use of the seaweed for feeding bangos.

Gathering of seaweeds. — Some fishponds have a direct frontage with the shallow areas where thick growths of gulaman-dagat are found and sometimes a boat is not even necessary to carry these seaweeds to the fishponds. At present the gathering of seaweeds is a specialized occupation providing employment to many people residing around Manila Bay during the summer months. It is estimated that no less than 1,000 **tiklis** (bamboo baskets) of sea-

weeds each containing 35 kilograms are harvested daily from *Gracilaria* grounds of Manila Bay during the season. The price ranges from ten to twenty-five centavos per tiklis depending upon the distance of the place of delivery from the collecting area. For short distances only small bancas are used; for transporting seaweeds to the fishponds deep in the interior of Bulacan, Pampanga and Bataan provinces, big boats like the flat-bottomed **petuya** of 30 or 40 tons capacity are often used (Figure 2).

FIG. 2. Transporting gulaman-dagat; (left) by banca; and (right) by petuya.

Since the seaweeds grow in shallow water gathering them is extremely simple. The commercial collectors wade along the growing areas and roll the thick mat of seaweed with their feet and load them in their bancas with their bare hands. In many places the growth of seaweeds is so thick that petuya could be loaded with 30 to 40 tons of seaweeds in one to two hours from a small area.

Methods of stocking in ponds. — The seaweed collectors deliver the seaweeds either on the dike of the pond or right inside the designated compartments of the ponds (Figure 1b). Since the standard practice is to keep the seaweeds alive in the ponde until they are consumed by the fish, they are introduced into the ponds as soon as harvested, generally before the color turns to violet. To stock the ponds the seaweeds are reloaded in small bancas inside the ponds and scattered about until a carpet of seaweeds of uniform thickness, usually about half a foot, covers the entire bottom of the pond. The amount of seaweed to stock in a

pond depends on the cultural practice being employed and on the amount of residual food inside the pond. The seaweed is used either as supplementary feed or as a substitute feed. If the pond contains a certain amount of naturally produced filamentous algae, only a small amount of gulaman dagat is used and in this case it serves as a supplementary feed. The most frequent use, however, of gulaman dagat is as a substitute feed; that is, a crop of bañgos is raised almost entirely on this particular seaweed instead of on pond-produced lumut. The pond is stocked with seaweeds and fish as soon as the last crop is harvested, usually in November and December. The pond may be filled with the full amount of seaweeds necessary before fish is introduced, or the fish may be stocked with the first batch of seaweeds, the stocking of the latter being made throughout the growing period of the fish from January through May or June. Many pond operators, however, prefer to stock their ponds full with *Gracilaria* before fish is introduced.

The amount of *Gracilaria* to stock in the ponds depends largely on the judgment of the pond operator. Since no study has so far been made on the amount of seaweeds to raise bañgos from fingerling to marketable size, this phase of the use of gulaman dagat has not been placed on a purely scientific basis. In practice, the basis is to spread the gulaman dagat over the pond bottom to a sufficient thickness so that the algae on the bottom will not decay too rapidly to asphyxiate the fish. The rate of stocking of algae is discussed in detail under the subject "Pond production with the use of *Gracilaria*."

Gracilaria grown over with filamentous green algae are preferred by pond operators to pure gulaman dagat, and for this reason, command a higher price. These mixed growths are stocked in **bansutan** or fingerling ponds and fed to bangos fingerlings in the belief that the young bañgos would partake of the lumut during the first months of culture and of the gulaman dagat later.

BEHAVIOR OF GRACILARIA IN PONDS

Since this specie of algae is heavy, it tends to settle close to the bottom of the pond and because of this characteristic, its distribution in the ponds is not much affected by the wind. A pond fully "loaded" with *Gracilaria* looks empty at a distance. The fish have a wide space on the top layer of the pond water wherein to roam freely but no shade is available to them, a situation doubly objectionable since the *Gracilaria* is used for feed only during the hot summer months. To help remedy this situation, fishpond operators increase the depth of their pond water to as much as it is possible with the summer tides. Since *Gracilaria* are red algae, they can be kept alive in deep ponds in fairly thick layer.

Salinity requirement. — Since the conventional practice of most fishpond operators in Bulacan and Pampanga is to stock their fishponds with seaweeds in amounts sufficient to support a crop of fish for one whole growing season without depending much upon food that may be naturally produced in the pond, the seaweed introduced must be kept alive until consumed by the fish. By popular experience gulaman dagat could be kept alive only in ponds near the sea where the salinity of the water is fairly high. The limit of tolerance of the seaweed to water salinity as far as the present survey could determine ranges from 5 to 30 p.p.m. The optimum salinity appears to fall within the range of 10 to 15 p.p.m. Higher salinities are well tolerated but there is a fairly sharp negative reaction to salinities lower than 5 p.p.m. Fish ponds close to the sea coasts have little or no salinity problems since the water in these ponds are generally salty enough for *Gracilaria* to thrive in. In fact, in many of these fishponds *Gracilaria* grow naturally, although not as luxuriantly as in their natural habitats. Seaweeds introduced were observed to grow, some operators reporting volumetric increments of as much as double the original stock. On the other hand. when gulaman dagat is introduced in large quantities in fishponds of low salinity it soon undergoes decomposition which often results in the killing of the fish stock. The salinity of the pond water is therefore a limiting factor in the use of fresh gulaman dagat as a supplementary bañgos feed on a large scale.

Nutritive value. — A common observation of bañgos pond operators is that only a small quantity of seaweeds is eaten by bañgos compared with lumut. These same operators used to purchase river or sea lumut but soon discovered that aside from the fact that seaweeds are cheaper to buy than lumut, it requires less gulaman dagat to raise bañgos. No experiments have so far been made to substantiate this claim. Some light, however, may be gleaned in Table 1 to establish the basis for this experience. This table shows the nutrient contents of gulaman dagat, water hyacinth, and lumut jusi *(Chaetomorpha). Gracilaria* is shown to contain more protein in the fresh state than any of the lumut jusi, which are the common species of algae grown in bañgos ponds. It is possible that the comparatively high food value of *Gracilaria.* could be the explanation for its being less consumed than lumut to produce a crop of fish.

Pond production with the use of *Gracilaria* — The use of *Gracilaria* as feed for bañgos has made it easy to make two, and sometimes three, harvests a year, where only one crop a year or three crops every two years was the cultural practice. The time ordinarily used to grow a sufficient crop of lumut inside the pond, which is usually from two to three months, is saved for actual fish production. The cultural practice in *Gracilaria*-using ponds is to harvest the fish in December or January when prices are high and to fill the ponds with *Gracilaria* immediately thereafter. Finger-

lings of **garongin** size (four to six inches in length) are introduced to be raised largely on *Gracilaria.* This crop of fish is harvested about the end of May or June. The pond is then rested for about two months to grow lumut on which the second crop of fish will be raised.

TABLE I.—ANALYSIS OF FOOD VALUE OF SOME PHILIPPINE SEAWEEDS.

Scientific Name	Common Name	Moisture %	Ash %		Fat %		Protein %		Carbohydrates %	
			F	D	F	D	F	D	F	D
Gracilaria confervoides	Gulaman dagat	6.92	15.31	16.48	0.4	—	11.98	12.89	65.39	70.63
Enteromorpha intestinalis	Bitukang manok	81.35	6.02	32.27	0.48	2.57	3.66	19.61	8.49	45.55
Chaetomorpha sp.	Lumut jusi	85.50	2.82	19.50	0.27	0.71	3.72	27.66	7.87	52.13
Cladophora sp.	Lumut jusi	57.2	9.90	23.16	0.84	1.96	5.16	12.07	26.90	62.81
Eichornia crassipes	Water hyacinth	89.81	1.34	13.15	—	—	2.19	21.49	6.66	65.36

F — Fresh weight basis
D — Dry weight basis

Proximate chemical analysis was done by Mr. Jose I. Sulit, food chemist, Bureau of Fisheries.

The amount of gulaman dagat stocked in ponds ranges from 60 tiklis (about 200 kilograms) to 140 tiklis (about 500 kilograms). The amount would naturally be limited by the carrying capacity of the pond; that is, the amount it can keep alive for a certain length of time. This amount is increased by introducing the seaweed from time to time throughout the growing period of the fish instead of in one batch. Since the amount of gulaman dagat in the pond can be easily controlled, the rate of stocking fish can, within certain limits, be adjusted accordingly. *Gracilaria*-users generally increase their rate of stocking fish from the ordinary rate of about 1,000 fish per hectare in ponds using lumut. Some operators stock their ponds at the rate of as much as 3,000 fish per hectare.

The cost of raising a crop of bañgos largely on seaweeds is surprisingly low. For instance, a ten-hectare fishpond "loaded" with 1,000 tiklis of fresh seaweeds which cost the owner ₱200.00 realized a gross income of ₱7,000.00 from the sale of fish produced. Another fishpond of 25 hectares was stocked with 2.000 tiklis of seaweeds valued at ₱400.00. This pond was planted with 150,000 bañgos fingerlings and the harvest was sold for ₱65,000.00.

The general concensus among fishpond operators in Bulacan and Pampanga is that they have increased their income twofold or more since they used *Gracilaria* as supplementary or substitute feed for bañgos.

Gulaman dagat in dry form.—The highly seasonal occurrence of gulaman dagat in Manila Bay precludes the use of this aquatic plant as feed for bañgos throughout the year. Furthermore, its sensitively to changes in salinity of water makes this seaweed an unstable feed in the fresh state and limits its use to fishponds close to the seacoast. The abundance of gulaman dagat during the summer months makes its conversion into dry form an ideal solution to the present limitations in its use. In the dry form gulaman dagat can be fed to bañgos at any time of the year whenever there is a shortage of naturally grown lumut. In this form it can be cheaply transported from the place of harvest to the place of utilization. Its use can be extended to the artificial feeding of strictly freshwater species since in dry form it will no longer require definite water salinities to maintain itself. It will be fed only as needed to prevent decomposition in the ponds.

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THE ECA[1] PROGRAM IN FISHPOND CULTURE IN THE PHILIPPINES

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During the last three decades, there has always existed the paradoxical problem of inadequacy of fish supply despite the availability of some potential natural resources in the Philippines. In 1950 the total fish production from the present fisheries was estimated at 220,190 metric tons as against the over-all needs of about 510,000 metric tons of fresh fish computed on the basis of 25.55 kilograms per capita nutritional requirement. The deficiency of more than 50 per cent is being partly filled by importation of canned fish and fishery products from other countries. This amounted to 29.000 metric tons valued at ₱12,944,314.12 in 1950.

With a coastal sea fisheries that is not overly-rich and is presently being overfished, there appears to be only two other ways to fill this wide gap between consumption and production; namely, to develop our high-sea fisheries by fishing in the extra-territorial waters around the Philippines and to develop the fishpond culture industry.

The first solution would increase our fish-producing area by exploiting the marine resources in international waters that surround our country. At present, however, we are largely unprepared to fish in these distant grounds. We do not have yet a thorough knowledge of their fisheries. We also do not have many of the suitable craft and gear necessary for international fishing and the shore installations for the efficient servicing of the fishing craft. The fishing countries of Japan, Formosa and Hongkong have been and are still taking active part in the commercial utilization of these world fisheries. It remains for our private capitalists and the government to make definite plans to undertake this lucrative venture.

The second solution, the expansion of our fishponds, appear to be the alternative capable of giving immediate and permanent relief to this pressing problem of food shortage. It can take advantage of the long-established reputation for stability and profitability of this industry and of the enthusiasm that has been generated by the consistent campaign of the Philippine government that capital be invested in this industry.

In consonance with the second plausible solution to the nation's fish shortage, the Philippine Bureau of Fisheries conceived and formulated a development program of fishpond culture with

1/ By recent act of the U.S. Congress, the Economic Cooperation Administration (ECA) has been placed under the Mutual Security Agency (MSA).

the financial and technical assistance of the Economic Cooperation Administration (ECA) in the Philippines. The main objectives of this program are to help increase fish production from existent resources by an intensive and extensive development of the fishpond industry and to rehabilitate and improve depleted inland fisheries through a properly integrated fish stocking system.

The ECA program will consist of the establishment of fishpond projects such as demonstration fish farms and fish nurseries at strategic places in the Philippines. It is expected that these projects will stimulate improvement in production on existing ponds and development in areas where it is not yet well established or not established at all.

This ECA program on fish culture in the Philippines is a ten-year development program. As planned, the fish farms to be established will be liquidated to private enterprises at the end of the program. The fish nurseries, on the other hand, shall be retained as continuing service projects to serve both artificial ponds and natural inland waters.

PRESENT STATUS AND PROSPECTUS FOR EXPANSION OF THE INDUSTRY

As of July, 1951, there were 82,323 hectares of developed bañgos fishponds in the Philippines with a total investment of around 160 million pesos. In 1950 these fishponds produced a total of 25,464 metric tons equivalent to about 12 per cent of the total national fish production. On the basis of 10 persons per 100 hectares about 8,200 laborers are gainfully employed annually in the fishpond industry.

Tabe 1 shows the acreage of developed brackish water fishponds and underdeveloped swampy lands by provinces in the Philippines. It will be seen that about 600,000 hectares of both brackish and freshwater swamplands are still available for conversion into fishponds. The potential salt-water mangroves are concentrated in Zamboanga, Palawan, Samar, Sulu, Capiz and Quezon Provinces, while those of the fresh-water, are in Cotabato, Agusan, Pampanga, Laguna and Nueva Ecija Provinces.

Fresh-water fish culture. — The fresh-water culture is comparatively a new industry. Recent estimates (1950) place the total acreage under cultivation at about 50 hectares; the biggest single unit is about four hectares in Tiaong, Quezon Province. The greatest handicap in the rapid development of the fresh-water fish culture in the Philippines is the lack of amenable species for fishpond cultivation. Most of our endemic fresh-water species like the **dalag** *(Ophicephalus striatus)*, **martiniko** or **liwalo** *(Anabas testudineus)*, **hito** *(Clarias batrachus)* are cannibalistic and do not readily multiply in captivity. Our indigeneous species of cyprinids, majority of which are endemic to Lake Lanao, are

TABLE I

AREAS OF DEVELOPED AND UNDEVELOPED SWAMPS AND INLAND FRESH-WATER IN THE PHILIPPINES

PROVINCES	DEVELOPED AREAS (In hectares)		UNDEVELOPED SWAMP AREAS (In hectares)		FRESH-WATER LAKES AND LAGOONS
	PRIVATELY OWNED	LEASED FROM GOVERNMENT	FRESH WATER	MANGROVE	
Abra	—	—	—	—	
Agusan	—	73.65	51,020	4,350	
Albay	—	2.00	—	500	
Antique	112.40	—	—	200	
Basilan	—	49.00	—	—	
Bataan	2,508.40	40.47	—	7,050	
Batangas	201.88	—	140	1,530	
Bohol	100	564.4	450	18,500	
Bukidnon	—	—	960	—	
Bulacan	16,875	99.26	450	14,710	
Cagayan	—	—	1,572	6,972	
Camarines Norte	—	128.94	—	6,810	
Camarines Sur	—	20.3	—	14,368	
Capiz	6,866.78	5,500	—	23,380	
Catanduanes	—	—	—	1,540	
Cavite	383.05	14.26	—	—	
Cebu	152.71	1,024.26	200	3,590	
Cotabato	—	2,179.86	75,200	5,760	
Ilocos Norte	65	—	—	—	
Davao	100	2,036.52	2.960	5,760	
Ilocos Sur	—	.96	—	—	
Iloilo	4,255.39	5,842.98	—	13,410	
Isabela	—	—	1.350	350	
La Union	179.19	23.62	—	—	

Laguna	—	—	3,759	—	43,000
Lanao	—	242.91	—	5,100	
Leyte	27.88	218.99	2,630	6,840	
Marinduque	—	40.10	—	3,018	
Masbate	—	314.01	—	13,550	
Mindoro	40	638.96	450	12,800	
Misamis Occidental	—	206.5	—	7,120	
Misamis Oriental	—	339.10	—	1,140	
Mountain Province	—	—	—	—	
Negros Occidental	1,753.37	3,410.26	—	14,680	
Negros Oriental	34	275.65	—	3,050	
Nueva Ecija	—	—	2,320	—	
Nueva Vizcaya	—	—	—	—	
Palawan	250	6.24	—	39,950	
Pampanga	12,611.96	11	21,040	24,030	
Pangasinan	5,469.45	1,860.14	1,790	1,410	
Quezon	125	429.9	—	21,150	
Rizal and Manila	1,625	10.33	416	—	50,000
Romblon	3.73	352.78	—	600	
Samar	—	888.00	—	30,620	
Siquijor	—	—	—	250	
Sorsogon	—	181.00	—	6,080	
Sulu	—	—	—	28,537	
Surigao	—	4.9	—	16,890	
Tarlac	—	—	950	—	
Zambales	72.76	318.43	—	1,410	
Zamboanga	192.30	1,157.37	1,007	63,400	106,400
TOTAL	53,336.05	28,467.05	168,657	430,405	199,400
GRAND TOTAL	82,323.10		599,062		

Data obtained from the Bureau of Fisheries and Bureau of Forestry as of June, 1951.

relatively small in size and have not been adopted for cultivation in ponds. This natural short-coming of our local species has, however, been remedied through the importation of several species of pond-raised fishes which have thrived well under local conditions.

Introduction of fresh-water species. — There has been a series of fish introductions into the Philippines undertaken principally by members of the staff of the Bureau of Fisheries. (See Table 2).

Of the food fishes introduced, the common carp *(Cyprinus carpio)*, or snake **the plasalit** skin goramy *(Trichogaster petoralis)* and the pearl goramy *(Trichogaster leeri)* are established in widely scattered natural waters (lakes, fresh-water marshes and rivers) in the archipelago. The small mouthed black bass *(Micropterus salmoides)* and the loach or weather-fish *(Misagurnus anguillicaudatus)* have acclimatized themselves in the mountain lakes and streams of the Mountain Province

Among the recent introductions of fish, the **tilapia** *(Tilapia mossambica)*, a mouth-breeder, is one of the most promising. It breeds very fast and thrives both in fresh and salt water. In Singapore, this fish is raised with shrimps, mullet and bañgos in the brackish ponds. It is especially adapted for fish stocking in waters which abound in carnivorous endemic species much as the **dalag, hito** and **tinikan** whose depredations it can survive by sheer speed of multiplication and by its habit of incubating the eggs and taking care of the young in its mouth.

Prospect for expansion.—The over-all prospect on the economic development of the fishpond culture industry is undoubtedly bright. The potential available sites are extensive (see Table 1). With the gradual decline of the coastal fisheries, investors are diverting their interests into the fishpond industry. The projected financing programs by the Rehabilitation Finance Corporation and the ECA financed fishpond demonstration and fish nursery projects are stimulating factors in the rapid development of this industry.

The use of machines in fishpond construction and operation has been successful. Bulldozers and mechanical shovels (cranes) have considerably reduced construction costs and rates. Fishpond sites which are relatively high to get needed water supply from the diurnal effects of the naturally fluctuating tides are now installing centrifugal pumps. With these pumps water in the pond can be drained, cleaned and freshened at will.

THE SPECIFIC PROJECTS UNDER THE ECA PROGRAM

To attain the main objectives of the ECA Program in fishpond culture certain specific projects have been proposed for proper implementation. The program will center on the establish-

TABLE 2—HISTORY AND STATUS OF INTRODUCED POND FISHES INTO THE PHILIPPINES

DATE	COMMON NAME	SCIENTIFIC NAME	SOURCE	INTRODUCED BY	REMARKS
1905	Mosquito fishes	**Cambusia affinis Fundulus heteroclitus** and **Mollinesia latipinna**	Honolulu, Hawaii	A. Seale	Established in fresh and brackish waters around Manila Bay.
1907	Small-mouthed black bass	**Micropterus salmoides**	Folsom, California	A. Seale	Established in Trinidad River and Lake and Burnham Pond, Baguio City.
1915	Common carp	**Ciprinus carpio**	Hongkong,	A. Seale	Established in Bicol Lakes, Laguna de Bay and Lake Lanao.
1925	" "	**Ciprinus carpio**	Canton, China	A. W. Herre	
1926	" "	**Ciprinus carpio**	Formosa	H. R. Montalban	
1927	Giant goramy	**Osphronemus goramy**	Java	A. W. Herre	Commonly raised in ponds in many parts of the Achipelago.
1935	Catfish	**Haustor catus**	San Jose, California	W. Adams	
1938	Plasalit	**Trichogaster pectoralis T. leeri**	Bangkok, Thailand	E. Quisumbing	Established in Bicol Lakes, Candaba Swamps and Laguna de Bay.
1942 -43	Loach or Weather fish	**Misgurnus anguillicaudatus**	Japan	Japanese Occupation Government	Established in the streams of Mountain Province.
1950	Tilapia (Mouth breeder)	**Tilapia mossambica**	Bangkok, Thailand	D. V. Villadolid	Established in artificial ponds.
1950	Kissing goramy	**Helostoma tenmenchi**	Bangkok, Thailand	D. V. Villadolid	Under observation in acclimatization ponds.
1951	Blue gill	**Lepomis microchirus**	Steinhart Aquarium, San Francisco, Calif.	Jose R. Montilla	Under observation in acclimatization ponds.

ment of the following specific projects which will gear the economic development of the fishpond industry:

Fish Farms	Location	Initial Area (Hectares)
1. Project No. 3—Laguna Freshwater Pilot Fish Farm	Bucal, Calamba, Laguna	5
2. Project No. 4—Alaminos Saltwater Pilot Fish Farm	Alaminos, Pangasinan	10
3. Project No. 6—Bicol Saltwater Pilot Fish Farm	Balongay, Calabanga, Camarines Sur	10
4. Project No. 7—Agusan Saltwater Fish Farm	Butuan, Agusan	10
Fish Nurseries		
1. Project No. 1—Central Saltwater Fish Nursery	Navotas, Rizal	5
2. Project No. 2—Central Freshwater Fish Nursery	Tanay, Rizal	5
3. Project No. 5—Batangas Saltwater Fish Nursery	Lemery, Batangas	5
4. Project No. 8—Koronadal Valley Freshwater Fish Nursery	Tupi, Cotabato	5

OTHER SERVICES TO BE EXTENDED BY THE PROGRAM

Technical aid. — The technical services to be extended as a part of the extension service of the Bureau of Fisheries will be further expanded to cope with the increasing requests for this kind of service both from private and other government institutions. Experienced technical men of the Bureau will attend to the needs of fishpond operators such as selection of site, preparation of plans and prospectus, and in some cases even to the extent of the initial supervision of the construction of the ponds. Experienced men in the industry and graduates of Fish Culture of the Philippine Institute of Fisheries Technology will also be made available to help manage and operate commercial fishponds.

The proper use of organic and artificial fertilizers and other improved culture practices in the ponds are other technical services that will be amply demonstrated by the projects.

MANAGEMENT AND OPERATION OF SPECIFIC PROJECTS

Demonstration fish farms.—Three saltwater fish farms and one freshwater fish farm will be established under the program. Each fish farm will be started with an area of ten (10) hectares

for saltwater fishpond and five hectares for the freshwater pond. This initial area will be gradually increased as conditions warrant by ten hectares in the case of saltwater ponds and by five hectares in the case of freshwater ponds every year so that at the end of the ten-year program a total area of 100 hectares of saltwater ponds and 50 hectares of freshwater ponds will be fully established. By that time each of these projects is expected to be a going concern and could be turned over to private enterprises.

Each fish farm will be operated on a commercial basis, while at the same time serving as a demonstration station from which people in the surrounding areas may learn advanced methods of constructing and operating fishponds. It will also serve as training grounds for skilled labor and apprenticeship-in-industry of fish culture students of the Philippine Institute of Fisheries Technology of the Bureau of Fisheries. Each demonstration fish farm will be managed by two specially trained technical men assisted by one or more helpers and emergency workers.

Fish nurseries. — Two saltwater and two freshwater fish nurseries will be established under this program. Each nursery will be started with an area of five hectares to be increased by five hectares every year for a ten-year period. These nurseries will raise and propagate suitable species of carp that will be imported from Indonesia, Calcutta and Hongkong. The already-established **gouramy** and **tilapia** will also be propagated in these fish nurseries since it will be a part of the program to raise the giant gouramy intensively in the freshwater fishfarms in combination with carp and tilapia.

The fish nurseries are primarily intended to serve the public by providing fry of fish at all times of the year, and only secondarily as income-producing projects. A part of the fry raised in these nurseries will be sold to private and government fishponds, but the bulk will be used for sustained stocking of freshwater lakes, lagoons and rivers to increase the productivity of these much-abused and long-depleted communal waters. Among the more important freshwater units to be stocked with gouramy and tilapia are Laguna de Bay, Lake Taal in Batangas Province, Lake Naujan in Mindoro and Liguasan Marsh, Lake Lanao and Lake Mainit in Mindanao.

The saltwater fish nurseries will also propagate and rear the commercial fry of indigenous species, such as those of bañgos *(Chanos chanos)*, sugpo *(Penaeus monodon)*, mullet *(Mugil* sp.), etc. However, the fry of muslo *(Caranx sexfaciatus)*, maliputo *(Caranx ignobilis)*, buan-buan *(Megalops cyprinoides)*, bidbid *(Elops hawaiensis)*, eels *(Anguilla mauritiana)*, and other fry of commercial catadromus species will be collected along the shores and in tidal lagoons during the fry seasons and reared for a few weeks in the nursery ponds. After attaining a certain size they will be

transplanted in Laguna de Bay, Lake Taal and Lake Naujan. In these natural bodies of water these fish grow to maturity and their migration to the seat at certain times of the year will form the basis of important fisheries in these lakes.

These fish nurseries are expected to stimulate the development of more freshwater and saltwater fishponds in their surrounding areas and farmers will take advantage of the easy availability of fry by stocking them in the rice paddies as a catch crop of rice. This practice is well established in such rice-growing countries as Japan, Indonesia, Thailand and India. We hope to develop in the Philippines the farmer-fisherman type of food producers in our rural areas who not only harvest rice but also fish. By this system the farmer not only will be able to provide himself with rice but also with fresh fish. One of the discouraging aspects of Philippine farm life is that the farmer has to depend largely on salted fish, if he could get it, for much of his protein need. The establishment of fish nurseries in the rural areas is expected to encourage farmers to raise their own fish right on their own farms and backyards.

The saltwater fish nursery for bañgos is expected to help encourage the development of the tuna longline fishery which badly needs a consistent source of bait. Bañgos fingerlings of from six to eight inches long have been found to be one of the best baits for tuna. Bañgos baits are in great demand in the longline fisheries in Formosa and Southern Japan. Since bañgos fry are not found in large numbers in these places, there had been numerous requests to lift the ban on the exportation of bañgos fry outside the Philippines. This prohibition was made to forestall any possible shortage of fry for the rapidly growing bañgos fishpond industry. It is, however, believed that if a more thorough catching of fry is made from the present known fry grounds, enough excess could be made from which a sizeable local trade in bañgos bait could be developed.

As in the case of the demonstration fish farms, the proposed fish nurseries will be managed by two well-trained fish culturists. With the exception of those to be transplanted in communal waters, fish fry reared in these nurseries will be sold to established fishponds through the regular commercial channels. At the end of the ten-year program, these fish nurseries will be retained as continuing semi-commercial and service projects of the Bureau of Fisheries. They will be operated to continue the restocking program of inland waters and to supply fish fry to commercial fishpond operators.

Leasing of construction equipment. — In order to facilitate the rapid expansion of the industry by private enterprises, the program will lease to them various types of mechanized equipment for clearing, construction and excavation work of the fishponds. Mechanical saws for clearing, bulldozers, cranes and scrapers for

excavation and grading work and pumps for draining and filling purposes will be made available in each site of the projected fish farm. This pool of equipment may be disposed of at the end of the program to private enterprises.

OTHER PROJECTS UNDER THE ECA PROGRAM

Importation of other exotic fresh-water species. — In order to further improve especially our freshwater fish stock, the project of importing various species of carp was also included in the program. In China, India, and Japan, the tri-dimensional system of fish stocking is being practiced. In line with this project the following exotic fresh-water species will be imported for stocking and propagation in combination with the culture of the common carp, grey mullet and milkfish in our waters.

Common Name	Scientific Name	Habitat
1. Grass carp	*Ctenopharyngodon idellus*	Upper layer grass feeder
2. Black carp	*Mylopharyngodon picus*	Snail and shellfish feeder
3. Big head	*Austichthys nobilis*	Sticky macroplankton feeder
4. Silver carp	*Hypothalmichthys molitrix*	Omoniplankton feeder
5. Mud carp	*Cirrhina molitorella*	Bottom feeder

From Calcutta, India, the following fast growing species of carp are also to be imported:

Common Name	Scientific Name	Remarks
Catla	*Catla catla*	Plankton feeder, attain 4 or 5 kilograms
Rohe	*Labeo rohita*	Omnivorous
Mrigal	*Cirrhina mrigala*	Fast-growing and good eating
Calabasu	*Labeo calabasu*	Omnivorous, hardy

Technical assistance program. — For the proper execution and operation of the different specific projects, a technical assistance program has been recommended. This program consists of three definite categories. First, an American fishpond expert will be sent here to advise on project planning, execution, mechanization of construction and on advanced methods of fish cultural operations. Second, a group of three Filipino trainees will be sent abroad for a period of from three to six months. Two of these will be sent to the Far East and Southeast Asian countries and one to the United States to make observations on modern methods of fish culture, fishpond construction, management and operations. Third, two additional Filipino technicians will be recommended as technical procurement officers to be sent to Hongkong and Calcutta to select and arrange for the importation of suitable fishpond species.

Upon return of these Filipino trainees, they will take charge of the operation of the various field projects. They will also form

the nucleus of a group of fishpond extension men who will cater the latest trends in this field of fisheries.

HOW THE PROJECTS ARE TO BE FINANCED AND SUPERVISED

Total outlay. — An initial outlay in the amount of ₱1,304,000 has been recommended by the Bureau of Fisheries. Of this amount ₱500,000 has been allocated for the operation and maintenance of the various projects for the last two quarters of 1951-52 and the balance for the purchase of necessary equipment and supplies. On this basis an allotment of about a million pesos will be necessary for the first year of operation and maintenance exclusive of construction equipment, supplies and foreign technical assistance.

Present Philippine Government appropriation for fish culture.—During the fiscal year 1950-51, the Philippine Bureau of Fisheries has undertaken the construction and maintenance of the following fishpond projects:

Name	Location	Area in Hectares	Remarks
Pontevedra Salt-water Demonstration Fish Farm	Pontevedra, Occ. Negros	10	Under Construction
Lala Demonstration Salt-water Fish Farm	Lala, Lanao	15	— ditto —
Pamplona-Claveria Salt-water Demonstration Fish Farm	Claveria, Cagayan	10	— ditto —
Dagatdagatan Salt-water Experimental Fishery Nursery	Navotas, Rizal	10	Continuing project
Tanay Fresh-water Propagation Station	Tanay, Rizal	1	Continuing project

For the construction, operation and maintenance of these five projects, the total amount of ₱106,730 has been made available. Of this amount ₱73,020 was set aside for the construction and development of the first three salt-water demonstration farms. These existing funds are inadequate and will require ECA financial assistance.

Peso and dollar requirements.—As a basic requirement of the PHILCUSA and MSA-STEM (Philippine Council for U.S. Aid—Special Technical and Economic Mission), two organizations taking charge of the processing and final approval of all ECA projects, the peso and dollar requirements of the specific projects have

been prepared. In the fishpond culture and development project, there are recommended eight specific projects with a total peso counterpart in the amount of ₱500,000 and $407,000 dollar counterpart (see Table 3).

Table 3—Summary of Project Estimates Including Administration and Supervision

Peso Counterpart

Project Number	Amount Alloted	Location
Administration	₱151,194	Manila Office
Project No. 1	37,366	Navotas, Rizal
Project No. 2	28,760	Tanay, Rizal
Project No. 3	41,080	Calamba, Laguna
Project No. 4	51,890	Alaminos, Pangasinan
Project No. 5	39,600	Lemery, Batangas
Project No. 6	54,340	Calabanga, Cam. Sur
Project No. 7	57,580	Butuan, Agusan
Project No. 8	38,190	Tupi, Cotabato
TOTAL	₱500,000	

Dollar Counterpart

1. Construction equipment and accessories	$139,858
2. Vehicles and transplanting equipment	76,200
3. Engines	34,342
4. Laboratory and refrigeration equipment	24,425
5. Tools and shop equipment	12,084
6. Supplies	70,091
7. Technical assistance	45,000
TOTAL	$402,000

Loans for private fishponds.—Since 1939 the Rehabilitation Finance Corporation of the Philippinesn has initiated the agricultural loaning system. Under this plan titled fishponds and/or titled real estate were used as loan collaterals for borrowing money for fishpond development. Sixty per cent of the appraised value of the titled property was allowed for loan. Appraisals range from ₱300 pre-war to ₱450 post-war per hectare plus ten per cent for every ₱10 increase of appraisal value per hectare. Many private fishpond owners who are already established were able to secure loans under this plan.

Under the new projected fishpond financing program sponsored by the Rehabilitation Finance Corporation (RFC) in cooperation with the Bureau of Fisheries, loans will be granted on both titled fishponds and government leased areas. Loans will be granted on areas up to 25 hectares only at ₱800 per hectare. On the basis of ₱1,000 as the cost of development per hectare,

the leasee shall be required to put initial improvement of not less than ₱200 per hectare duly declared for taxation. Other requirements include a 10-year lease agreement with the Bureau of Fisheries and confirmation by the same office as to suitability of the site applied for. Further details of this financing program may be secured from the Agriculture Department of the Rehabilitation Finance Corporation in Manila or its branches in the provinces.

MECHANIZATION OF THE PUKOT-PANULINGAN (HALF RING NET)

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The half ring net is known as **pukotan** in Batangas where it is used to catch offshore pelagic fishes. A similar type of net is used in Manila Bay and is called **talacop.** This article deals with the Batangas type and the latest attempt to mechanize its operation.

The half ring net is a tuck seine with a bunt flanked by two long and narrow wings. The name **half ring** net is derived from the pursing device, consisting of purse rings distributed on the lead line of the bunt to the middle portion of the wings. The gear operates by first surrounding a school of pelagic fish to form a complete ring. Then the wings are hauled in, at the same time pursing the bottom of the net. This latter operation concentrates the fish at the bunt from where they are brailed out.

There are two types of half ring nets used in Batangas Bay. The type depends upon the major species of fish caught. These are the **pukot-panulingan** and the **pukot-pangmiralya**. The former is used only in the daytime for catching tuna and bonito while the latter is used at night for catching slipmouth. The pukot pangmiralya is shorter and shallower than the pukot-panulingan. Because of the use of high-powered lights, the pukot-pangmiralya has not been used for the last few years. Fishermen claim that visibility is affected by luminous light while scouting for schools of fish.

The use of the half ring net dates back to the latter part of the nineteenth century. As first started, the outfit consisted of a small fishing boat and a simple rectangular net operated by 14 to 18 fishermen. This arrangement continued for years with little or no improvement in the gear or in the tecnique of its operation. About 1926 some Cavite fishermen modified the gear by using pursing weights or tom weights to hasten the pursing of the net. At present there are about fifty units of this type in operation representing an investment of ₱500,000.

The operation of the present outfit requires about 20 to 25 fishermen. There has lately, however, been a serious attempt

to reduce the number of men and extend the field of operation of this gear by introducing a certain amount of mechanization.

THE FISHING OUTFIT

The standard pukotan outfit uses a fishing boat of about 3 tons gross with bamboo outriggers and is man-powered. It is provided with 16 to 20 oars installed about the center to the bow. When there is favorable wind the boat is propelled by sail to and from the fishing ground. The net platform is located at the stern.

The net is locally woven from cotton twine either locally produced or imported. The size of the imported twine is 9-12 thread, U. S. standard. There is no standard measurement used to determine the size of the locally produced twines but as actually used in their loose state, their diameter would fall between 12 and 15 thread of the U.S. standard. The net is made of several rectangular strips of webbing called **bantasan**, which are laced together to form a curtain-like structure of about 250 to 300 fathoms in length and 15 to 20 fathoms in depth. The bunt section is the deepest portion of the net and has the finest meshes. The wings are shallower and of coarse mesh. The coarse mesh is for fast hauling. The float line and lead line consist of two 5/8-inch diameter rope made from abaca, maguey, or cabo negro. To one of the ropes of the float line are strung 1,000 to 1,200 wooden floats or **gamao,** which are made from **hinugdung** (*Trema aspera* Blume). The distance between floats varies from 3 to 5 feet at the outer portion of the net and gradually decreases to about 1 foot towards the bunt section. The floats vary in size, measuring from 5 to 9 inches in length and 3 to 4-1/2 inches in diameter. The lead line is always shorter than the float line for easy pursing of the bottom of the net. Leads or stones of variable weights are strung to one of the ropes of the lead line. The purse rings are made from 5/6-inch brass with an inside diameter of 3 inches. These rings are evenly distributed by bridle ropes along the lead line from the bunt to the middle portion of the wings. The pursing rope which runs through the rings is 1 inch in diameter. It is made either from abaca or maguey. The pursing weight varies in shape and size and weighs about 160 pounds.

The pukotan has recently been mechanized. A 225 h.p. Gray-marine diesel engine has been installed to propel the boat and handle the pursing rope mechanically. (See Figure 1). A power transmission drive is installed for both the port and starboard pursing winches. Also installed is a pursing davit and fairlead. The boat brings along with it a powered skiff. To increase its

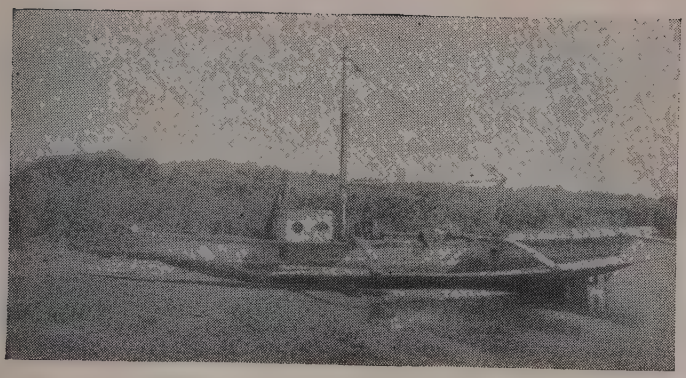

FIGURE 1. Mechanized **panulingan.**

carrying capacity and make it more sea-worthy, the boat is made deeper and wider. (See Figure 2).

The net is made of 9-thread U.S. cotton twine. The length of the float line is increased from the conventional length of 250-300 fathoms to 360 fathoms and the depth is increased to 23 fathoms. The lead line is 10 and 20 per cent shorter than the float line at the bunt and wings, respectively. Lead weights of about 6 ounces each are strung to one of the ropes of the lead line. The distance between leads is 34 inches. There are 34 pursing rings distributed from the middle portion of the wings to the bunt. The specifications of the net is shown in the following table:

Parts of net	Number of strips	Size of mesh in inches (Stretched measure)	Length in fathoms per strip	Depth in fathoms	Local name of strip according to size of mesh
Wings (from end to bunt)	2	9	36-1/2	20	Panambacol
	6	9	36-1/2	21	Panambacol
	2	5	18-1/5	21	Panulingan
Bunt					
Upper section	2	2-1/2	9	11	Pangluma-han
	3	1-1/8	4-2/3	6	Panghamalit
	2	1-3/4	7	5	Pangbilog
Middle section	3	2-1/2	10-2/3	6	Pangluma-han
Lower section	2	5	16	6	Panulingan

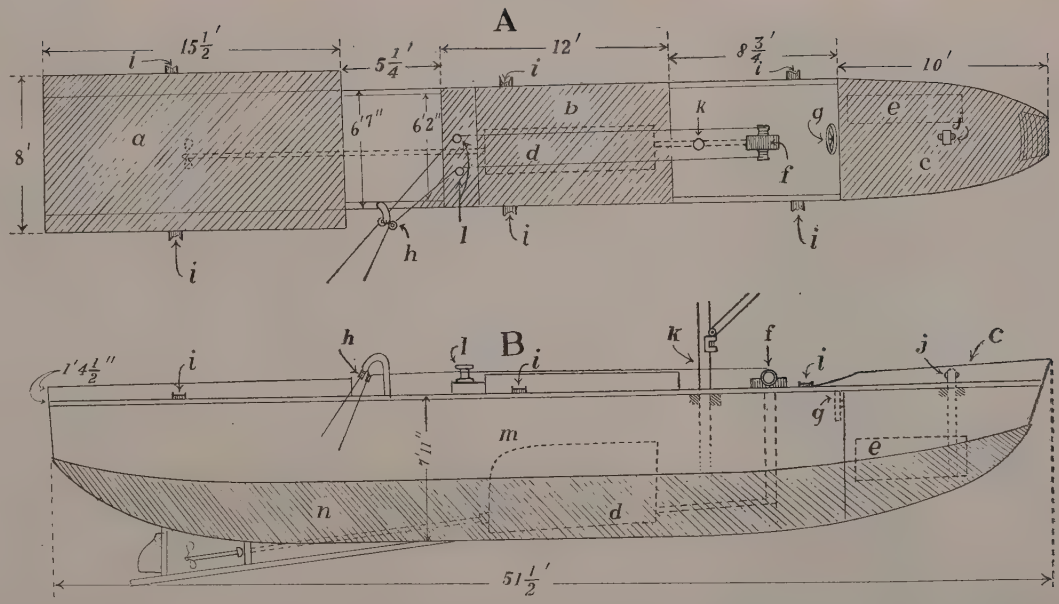

FIGURE 2. Details of a mechanized **panulingan**. **A**, top view; **B**, side view. Parts indicated are: **a**, net platform; **b**, engine top housing; **c**, fore deck; **d**, engine; **e**, tool box; **f**, winch; **g**, steering wheel; **h**, pursing davit; **i**, outrigger; **j**, bitt; **k**, mast; **l**, fairlead; **m**, side planks; and **n**, dugout.

THE FISHING OPERATION

There is not much difference in operation between the hand-powered and the mechanized gars. In the following paragraphs, the fishing operation of the mechanized pukotan is discussed.

The fishing outfit leaves for the fishing grounds, the skiff towed by the mother boat. When a suitable school of fish is sighted, the behavior of the school, the wind direction, sunlight, and current are carefully noted. When the boat has secured a correct position in approaching the school, the skiff-end of the net is released. The shooting of the net starts and the boat encircles the fish with accelerated speed while the net is continuously paid out until the boat reaches the free end of the net. As the net is being paid out, the skiff drives in the fish towards the bunt section. This phase of the operation takes about 3 to 5 minutes. The shooting of the net completed, the crew take their pre-assigned positions for hauling. The two wings are hauled in until the two ends of the pursing rope are reached. The purse ropes are passed through the pursing davit, through the fairlead, and hauled in by the power winches. The pursing weight is dropped and the pursing operation commences. The crew continue to haul in the net and the pursing ropes until the pursing weight reaches the surface of the water with all the rings. The weight is then secured on the side of the boat. By this time the fish are almost concentrated at the bunt. Here the catch is brailed out with a dip net to the powered-skiff and brought immediately to the market. When an extraordinarily large catch is made, excess fish are temporarily stowed in the fish hold without ice. The hauling phase of the operation takes from one-half to one hour or more depending upon the size of catch. The pursing weight is lifted on deck and the net repiled for the next shooting operation. Repiling of the net takes about one hour. From three to five hauls a day are made depending upon the abundance of fish. (Figures 3 and 4 show the nets being spread for drying and mending).

In the case of the man-powered pukotan, several fishermen using sail or row boats approach the fishing boat. These fishermen become some of the middlemen in the selling of fish. Sometimes the middlemen are eliminated and the fish are sold directly to the so-called **campamento** that takes charge of selling and preserving the fish in big scale. The campamento invests or lends money to the pukot operators and fish are purchased by the campamento at a lower price.

FIGURES 3 AND 4. The nets being spread for drying and mending.

FISHING GROUNDS

The present and potential fishing grounds for the operation of the half ring net of the Batangas type are Lingayen Gulf, the Zambales coast, Manila Bay, waters around Batangas and Mindoro, Ragay Gulf, waters off Southern Masbate, west coast of Panay Palawan and northern and southern coasts of Mindanao.

FISHING SEASON

In Batangas Bay tuna begin to appear in the latter part of November. Their appearance is very occasional until late March. The months of April and May form what is considered the highest peak of the tuna season. Tuna begin to break away in early June and finally disappear during the southwest monsoon called **habagat** until the following November when they repeat the same cycle. The tuna are best caught before sunrise and before sunset as they congregate in thick schools during these times. During daytime when the water is very clear, the schools are less dense and fast moving. Furthermore, the fish sound so deep and escape below the lead line, making their capture very difficult.

THE CATCH

The tuna and bonito are the species mostly caught by the half ring net in Batangas Bay and Balayan Bay. Occasionally caught with them are skipjack or striped tuna, moonfish, cavalla, round scad, and hardtail. Generally, one-third of the money derived from the catch goes to the pukot owner and two-thirds is divided among the fishermen. The members of the crew who mend nets and do extra work while the boat is on shore are given higher shares. If the boat is fishing in distant grounds, expenses for food are deducted from the money after the fish are sold before it is divided.

COST OF THE OUTFIT

The following is an estimate of the cost of a mechanized hall ring net and shore equipment on the basis of prices in June, 1951, in Batangas Province:

Boat (length, 52 feet overall; depth, 3 feet, 10 inches; beam, 6 feet, 1 inch)	₱ 3,000.00
Engine, 225 h.p. Graymarine, plus cost of installation	5,000.00
Two half ring nets complete with accessories at ₱7,500.00 each	15,000.00
One skiff with 7.9 h.p. outboard motor (length, 26 feet; breadth, 2 feet, 8 inches; depth, 2 feet)	1,200.00
Tanning tank	300.00
Drying racks, shed, etc.	200.00
Total	₱24,700.00

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1950. Guide to the classification of fishing gear in the Philippines. **U.S. Fish and Wildlife Service Research Report** No. 17, Washington, 165 pp., 53 figs.

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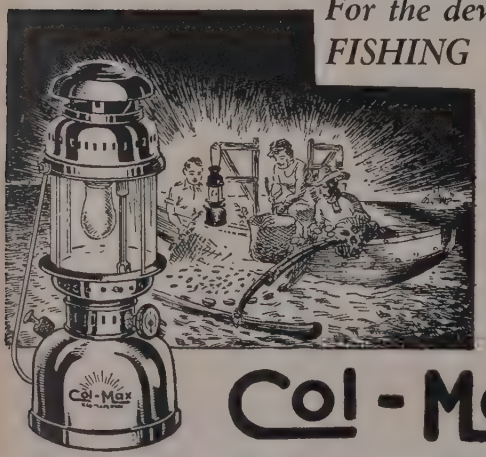

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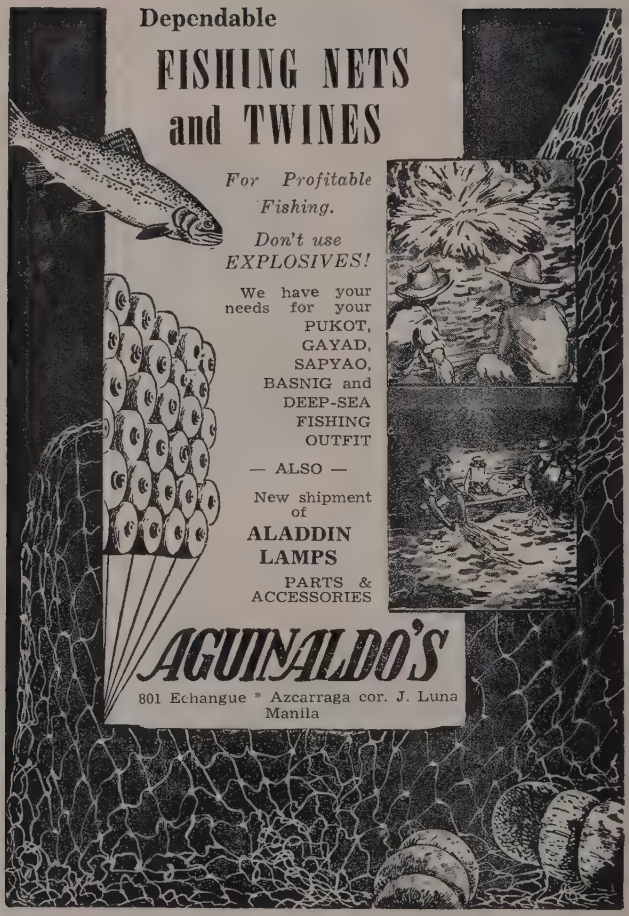
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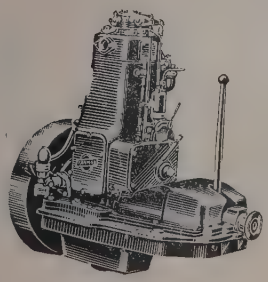

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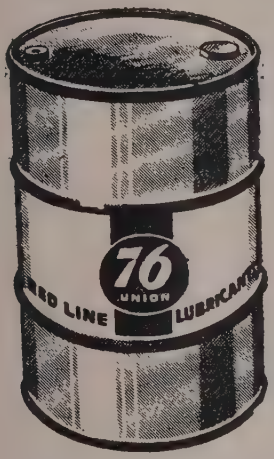

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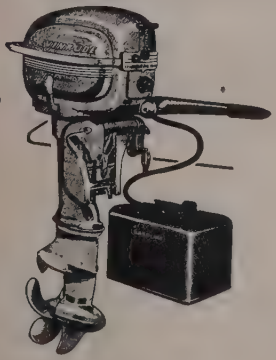

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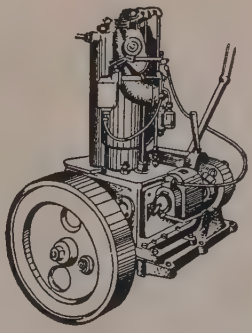

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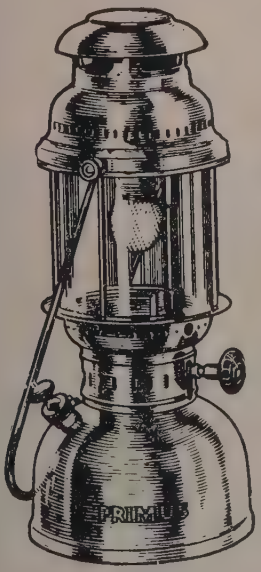

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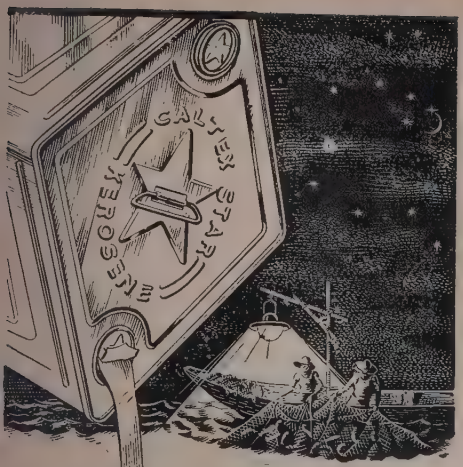

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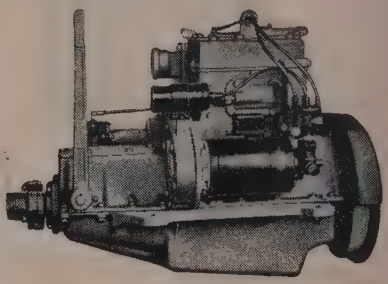
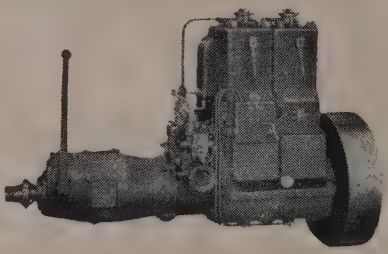


Calmo - diesel

MARINE ENGINES



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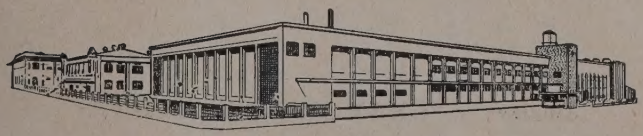

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